FINANCE COMMERCE ENGINEERING

THE FAR EASTERN REVIEW

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SIGNS OF BETTER DAYS IN CHINA

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Vol. XXX DECEMBER, 1934 No. 12

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ENGINEERING FINANCE COMMERCE

VOL. XXX SHANGHAI, DECEMBER, 1934 No. 12

Signs of Better Days in China*

By O. M. GREEN, former Editor of "The North-China Daily News," Shanghai

WHEN, at the close of July, the Communists erupted from their mountains in Kiangsi and tried to rush Foochow, China came on to the "front pages" again, Chinese loans were marked down a few points on the stock exchanges, and foreign gunboats hurried to Foochow to protect their nationals.

Yet the importance of the event lay precisely in a direction opposite to all appearances. Paradoxically, the Red attempt on Foochow was a sign of the Government's strength, not of its weakness. It was evidence that the blockade, which General Chiang Kai-shek, with the aid of Canton and Hunan, has been maintaining for several months past, had become so intolerable that the Communists were compelled to attempt a sortie. And, within a week, Government troops and aeroplanes were at the invaders, who dropped such prizes as they had gathered up and fled, Foochow was relieved, the gunboats returned to Hongkong and Shanghai, China came out of "the news."

It is a perennial grievance with the Chinese that Western newspapers have no room for anything about China except her civil wars and bandits. What she is trying to do to rehabilitate herself goes apparently unnoticed. The answer, of course, is easy. Bad news from any quarter is always news, good news only occasionally. Yet the destinies of the Far East are so vital to the whole world, that some understanding of what is happening there is of moment to all of us. No great exercise of imagination is needed to show what an orderly, reformed, and peaceful China must mean to the trade of other countries, and it is no exaggeration to say that China has done a surprising amount in the past two years in spite of many difficulties and deficiencies. There is plenty to criticize; political partisanship remains insular, obstinate, and greedy; it would be altogether inaccurate to speak of China as a united country. But at least there is a better understanding among her different administrations than existed three years ago, coupled with a distinct disinclination for civil war, except, of course, as regards the Communists; public opinion has become vocal; and in high places there is evidence of a better spirit, of a real desire to get things done instead of merely issuing grandiloquent proclamations of utopian schemes which impress no one except by their impossibility. Since the Revolution of 1911 China has never been more hopeful than she is to-day, nor, in spite of the limitation of its powers, has her Government possessed more prestige or been inspired with a more apparently sincere desire to achieve peace and prosperity.

The really extraordinary material development which has taken place in the past three years was described at great length in the report made to the League of Nations last April by Dr. Rajchmann, who went to China as co-ordinating officer of all the twenty-eight or thirty Advisers lent by the League to China. There is space here only for broad outlines, but they are sufficiently striking. In May, 1931, Nanking decided to set up a National Economic Council to take charge of all economic development, and to invite the League of Nations to lend experts to help it. Although this Council is presided over by the chief Ministers of the Government, it was intended to be, and in fact has been, free from political influences, especially anything in the nature of "pull." The highly satisfactory result has been to attract to its service numbers of men trained for work that needed to be done, eager to do it, but previously deterred from offering themselves because the only road to public service lay through attachment to some political *régime* or program in which they could not believe.

Many New Roads

Communications were the Council's first aim. By the end of last year over 8,000 miles of roads had been built in the central and eastern Yangtze Valley. Some of these, it is true, are only beaten earth. But rural China is not particular. After ages during which her widest thoroughfares would not allow much more than two wheelbarrows to pass, these broad new roads with motor-buses trundling along them to hitherto buried villages were a revelation. The buses might occasionally break down or stick in the mire, but their crowded passengers take such little *contre-temps* with the utmost philosophy. Many letters from the interior testify to the remarkable influence of the new roads in breaking down old parochialisms and opening rustic minds to new ideas.

Besides road-building much has been done in strengthening the old, and building new, dikes at dangerous points of the Yangtze and Yellow Rivers. Thousands of years of relentless cutting down of trees and stripping hillsides bare of vegetation have made China more liable to devastating floods than any other country. These were a problem as far back as in the semi-mythical days of the Emperor Shun, who won the two daughters of the Emperor Yao in marriage, and succession to the throne, for his skill in coping with the Yellow River. The elaborate dike system, built up through thousands of years, had fallen into sad disrepair in the early days of the Republic, and the repairs and extensions effected by the National Economic Council are unquestionably of high national value. The Council also has a scheme for conserving the Huai river, which runs through Central China, north of, and parallel to, the Yangtze, and cutting a proper outlet for its waters, which at present can only discharge into lakes in North Kiangsu. Millions of acres of rich land are thus to be saved from annual floods. But the undertaking is so gigantic and costly that one imagines it will remain a dream of the future for some time yet.

Railways, of course, engage a great deal of attention. China's entire system amounts to little more than 7,000 miles, of which 2,000 are unimportant branches. Years of civil war, during which rival Tuchuns devoured revenues, appropriated rolling-stock for the housing of their troops, and neglected the barest forms of maintenance, had reduced most railways to a pitiable condition. But in the past few years remarkable restoration has been effected. For this, it is true, the British Boxer Indemnity money, returned to China in 1930, about £11,000,000, is largely to be thanked. But the fact remains that the railways are being repaired, and in less than two years the gap in the Canton-Hankow Railway, through the difficult mountainous country on the borders of Hunan and Kuangtung, should be completed. China will then have a continuous railway system right through from Canton via Hankow to Peking—which, in fact, means that it will be possible to travel by train from Canton to Ostend. An entirely new railway,

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built by Chinese engineers, extends southwards from Hangchow through Chekiang and will eventually link up with the Canton-Hankow. And, as a small but none the less important convenience, by means of a train ferry across the Yangtze at Nanking, it is now possible to travel in the same carriage all the way from Shanghai to Tientsin. Those who remember the unhappiness of arriving at Nanking by night train from Shanghai, and the bleak discomfort on a cold winter's morning of the ricsha trip through Hsiakwan and the launch journey over the river, will appreciate the blessing this means.

China's railways have attracted very unfavorable attention abroad owing to prolonged default in her loan-engagements to foreign bondholders. Partial resumption of payments has begun in the past year or so: and last February Mr. Wang Ching-wei, the Prime Minister, issued a long statement emphasizing that China had no thought of repudiating her debts, but pleading that the same consideration should be extended to her as to other countries whose pledges have broken down through various forms of storm and stress. It is a reasonable contention. But as China's railways are undoubtedly beginning again to earn good money, it is to be hoped that interest payments in full will follow suit. The point is that, while several other countries are actually far worse defaulters, justly or unjustly China's railways have attracted most attention, and this must militate against her chances as a borrower when she comes abroad to borrow money, as sooner or later she must do for all the rehabilitation work that has to be done.

Other Achievements

Other activities of the National Economic Council in the general realm of social work can only be glanced at briefly. An extremely important part deals with public health, instruction in hygiene and establishment of health centers in country districts.

Food supplies are also engaging attention. That China, whose soil is as fertile as her peasantry is indomitably diligent, should every year be obliged to import more and more foodstuffs is little short of a disgrace. Partly this is due to antiquated methods of cultivation, partly to civil war and taxation, partly, it must be confessed, to the large extension of opium-growing forced upon the farmers by provincial militarists for the sake of the high revenue it yields. Thus it has recently been noted by missionary correspondents that large tracts of Hupeh, in which the poppy was formerly unknown, are now cultivating it to the extent of 25 to 30 per cent of land that should be growing grain. General Chiang Kai-shek has lately started a new campaign to stop both cultivation and smoking of opium, and there is never any lack of energy in his undertakings. But China is so great, the Government's effective power at any distance from Nanking so much restricted, and the profits on opium so lucrative, that suppression must be slow and difficult. Undoubtedly the only ultimately effective way of coping with the evil is to make opium a Government monopoly, in which the provincial governments would have their share, as has been recommended more than once, since 1856 onwards. But at present Nationalist "face" cannot tolerate a course that would publicly admit the existence of an evil officially supposed to be on the verge of being, if not already wholly, suppressed. "Face," the offspring of the classic ideal of a gentleman, cause among Chinese of so much smiling and admirable serenity in misfortune, is also the source of many evils.

Strange as it may seem, China's innate courtesy and good manners are frequently her greatest stumbling-block. A committeeman or councillor proposes some preposterous scheme; everyone present knows that it is futile or worse, but nobody can be so rude as to contradict him publicly and make him "lose face." So the proposal goes through, to the immense inconvenience, it may very well be, to China and everybody else.

Perhaps the most promising feature of the general reform movement is the recognition that now exists of the peasantry as the foundation on which China stands or falls. Some three years ago I described in *The Asiatic Review* the so-called "Tinghsien experiment," in which James Yen, a former Chinese student of Yale, is spreading not only simple education but also modernized methods of husbandry among the peasants of a selected district of Chihli, with the object of making it a model for others to copy. The experiment has had wonderful success, though as yet but few imitators. It has, however, undoubtedly served to attract attention to the peasant's sorely oppressed and necessitous plight. For those who know the Chinese it is impossible to believe that Communism can ever take root deeply among them. Its teachings are radically opposed to all the deepest instincts of the Chinese nature, property, individualism, and family. That there is a vigorous nucleus of genuine Communists in China, many of them Moscow-trained, who have succeeded in building up a stubborn, revolutionary State in the mountains of Kiangsi, is of course undeniable. But their armies and hangers-on are, for the most part, merely peasants driven wild by misfortune, who have turned outlaws as their ancestors had done again and again in eras of disorder.

Thus it was that, three years ago, General Chiang Kai-shek exclaimed that "the problem of Communism is three-tenths political and seven-tenths economic." His own plan of campaign against the Reds, as already indicated, has been changed—no more a campaign of movement, assault on impregnable hills, which destroyed the country it was supposed to save and won no battles, but a closely knit blockade. In villages around the Red area such necessities as rice and salt are obtainable only by licence, in order to prevent supplies from being smuggled to the Communists; and behind the lines of the blockade much has been done to revive the drooping countryside and bring the peasant back to his farm.

Since last March Nanking has made a regular monthly grant to the Kiangsi provincial government in exchange for the abolition of some of the most burdensome surtaxes: and, as from the beginning of July, it was decided that all the proceeds of the Wine and Tobacco Tax (traditionally, in China, a monopoly of the ruling body) should be retained by the provinces on condition of their taxation being lightened. The budget of the National Economic Council for 1934, totalling $15,000,000,* devotes, among its various allocations for road-building, improvement of cotton and silk cultivation, education, hygiene, etc., $1,900,000 to Kiangsi alone. In the *People's Tribune* for last August, Mr. Wang Ching-wei enumerates forty-two different sorts of levies and taxes in Kiangsi, twenty-seven in Hupeh, and no less than 280 in Chekiang which, he states, are definitely being abolished this summer. As these three provinces are those most directly under Nanking's control, it is reasonably certain that a part, at least, of these glowing anticipations will be realized. But the appetite for provincial perquisites has grown greatly by feeding and is hard to curb. Taxes have an unpleasant habit of disappearing under one name and immediately reappearing under another. Still, there is no doubt that the Nanking Government is in earnest, and from many sources it is clear that the farmer's lot begins to be a little lighter.

China's Armies

Until China solves the problem of disbanding her gargantuan armies, amounting in all provinces to at least 2,000,000 men perpetually under arms, economic progress must continue to be slow and partial. These armies are the accumulation of sixteen or seventeen years of Tuchunism, Communism, and civil war (reckoning from the death of Yuan Shih-kai), and, if anything, they tend to grow more rather than less. To disband the men and turn them adrift with a few dollars apiece, as has once or twice been tired, merely ends in their being enrolled afresh in the next provinces' army or swelling the ranks of brigandage. Land settlement on a large scale might be feasible, since every Chinese is by instinct a farmer, but that means money, and the soldiers already eat up nearly half the available revenues.

Nanking's budget for the year 1934-35 (July 1 to July 30), is balanced at a total expenditure of $777,302,226: the balancing, by the way, without fresh loans, is distinctly creditable, especially as on the expenditure side there is an item of $257,530,231 for the service of foreign and domestic loans. But of the remainder no less than $307,750,910 is earmarked for military expenditure. It is to be remembered also that each province has its own separate budget, and, when we get away from those directly under Nanking's control (broadly speaking the Yangtze Valley), its own armies. It has been estimated that in the so-called South-west Federation—Kuangtung, Kwangsi, Kweichow, Fukien and Yunnan, of which Canton is the titular head—military expenditure amounts to 70 or 80 per cent revenues. Nobody knows what it amounts to in the vast western province of Szechuen, as big as

*Roughly £1,000,000, which of course means very much more in China, where a peasant may be "passing rich" on £20 a year, than in the West.

all France, and naturally one of the richest districts in the world, but latterly reduced to the verge of ruin by internal civil war.

In recent years China has been spending largely on aircraft. Both Nanking and Canton sent special aviation missions to Europe during the past summer (charming people they were, by the way), who were extensively shown round as potential purchasers. What the result will be is not yet certain, but there are reports of large additional outlay projected by Canton. Nanking is said to have a fleet of 300 aeroplanes, and there is a huge aviation school at Hangchow, directed mainly by American instructors. It is only fair to add that civil aviation is being extensively developed. There are regular daily services now, radiating from Shanghai and Nanking to the principal centers, north, south and west, and a system is promised, via Kansu and Chinese Turkestan, but held up by the long confused fighting in the latter province, to link up with the Russian aeroplanes across Siberia to Europe. But all aviation in China is a Government monopoly, so that the machines now used commercially might be turned to purposes of war. Unquestionably the aeroplane has put tremendous power in Nanking's hands, as shown by the ease with which the recent Communist eruption (mentioned above) and the more serious revolt of Foochow last year were suppressed. Obviously, by aviation, Nanking can bring its strength to bear on distant points of disorder with a rapidity and terror that previous Governments never possessed. But it must be doubted whether China is not increasing her aeroplanes far beyond her real needs and means, and there can be no question that Japan eyes her neighbor's aerial ambitions with growing suspicion.

Fundamentally, of course, all China's problems center in the political question. Having discarded the Imperial system of 4,000 years it is hardly surprising that in only twenty-four she has not yet found a substitute suited to her needs. A community of feeling has developed between one province and another such as was unknown only a decade ago. Recognition is accorded to Nanking as the Central Government such as Peking never knew after the death of Yuan Shih-kai. But outside the Yangtze Valley provincial governments have a distinct idea of what orders they will and will not obey from Nanking. It is a happy circumstance that relations between the capital and Canton are much more amicable than they were a couple of years ago. A conspicuous example was the revolt of Foochow last year. The rebels counted as a certainty on the support of Canton, where General Chiang Kai-shek is not popular with many politicians, and the supposedly pro-Japanese policy of Nanking seemed a good battle-cry. But the strong common-sense of General Chen Chit-tung, the unacknowledged dictator of Canton, was dead against further futile and causeless civil war. Foochow was left to its own resources, with no real sympathy anywhere in China, which is sick of civil war, and the rebels were easily suppressed.

Canton Independent

It must, however, be pointed out that Canton is fully determined to manage its own affairs. A few months ago it was announced that the South-west Federation, mentioned above, was to be dissolved and its members were to come under the control of Nanking, but there is no sign of this prophecy being fulfilled. Since, in 1931, China recovered the right to frame her own tariffs, an enormous amount of smuggling has been going on from Hongkong, a free-trade port, to the mainland. It is indeed a question whether the unpleasant decline in Customs revenue during the past two years is not at least partly, due to this smuggling. Hongkong has no wish to live on bad terms with her vast neighbor, does what she can to check the smugglers, and would be quite willing to enter into an arrangement with Nanking which would suppress them entirely. But as Canton profits heavily by the smuggling, no arrangement is possible.

Under the instrument of government adopted in 1928, when Nanking became the capital, the Kuomintang made themselves the supreme authority, source of all power, eternal, unquestionable. They proved themselves, to put it mildly, quite unworthy of such omnipotence and, by a series of events too long to detail, have been largely outsted from it in Nanking and have fallen back on their old stronghold in Canton.

From a practical point of view, it is early to talk of a fixed constitution: indeed, it is doubtful whether the Chinese with their admirable gift for settling questions on common-sense *ad hoc* lines would not find such an instrument as much a nuisance as England has always instinctively felt it to be, while the mere attempt to write a constitution would arouse all sorts of dogs which are much better left asleep. Actually, in spite of many difficulties and abuses, China seems to be moving along lines which, given a few years of internal peace, should automatically develop into a system far more suited to a country so vast and disparate than the uniform machinery rigidly centered in one city such as the Kuomintang tried to force upon China in 1928.

The germs of this development are found in the declaration by Nanking in May, 1932, that thenceforward civil wars, except for defensive purposes, would be eschewed; if distant provinces wished to pursue "a particularist policy" (*leitotes* for doing what they pleased) Nanking would not try to prevent them: she would concentrate on reform and development in the Yangtze Valley and trust to the future and the good condition of her own domains to bring others into her orbit by the inevitable attraction of the prosperous for the unprosperous. On the whole Nanking has stuck very fairly to this principle, the only practicable one—as I think Professor Tawney has urged, namely, to take one area, however limited, and make that peaceful, orderly, and well-governed before attempting to go further—and, if it can be pursued resolutely, its benefits for all China are certain. The ultimate ambition might be a Federated or United States of China, which would reproduce, on republican lines, the old Imperial sytem of viceroyalties, which is thoroughly understandable by the Chinese and the only practicable scheme of governing so large a country, chequered with so many and wide differences of climate, custom, and temperament.

This is not the place to discuss foreign politics. But if China could bring hereself to accept some *modus vivendi* as regards Manchuria, and for the adjustment of differences with Japan, an immense cloud would be lifted from her own prospects and from all the Far East. The chief stumbling-block is Canton, which remains rigidly and explosively anti-Japanese. But it is certainly significant that the idea of coming to terms with Japan begins to be discussed in Central China with some approach to a sense of its merits. No Chinese, of course, is "pro-Japanese" (except, for propaganda purposes, in the mouths of his enemies), but more and more practical Chinese begin to realize that continued animosity between themselves and Japan is suicidal between neighbors so closely situated, and the surest way of bringing about the evils with which Chinese imagination is so darkly haunted.

It would be easy to pick holes in what China is trying to do to-day. Graft, arrogance, insubordination, and political hatreds are still bitter; the rule of law continues to be more honored in the breach than the observance; taxation is still intolerably burdensome; foreign policy is mistrustful (possibly not altogether without cause) and still largely blind to its own interests.

Real Progress Made

Yet beneath all "life's enormous disarray" there is a stirring of the dry bones which points to a real and vigorous spirit at work. It is immensely significant that the retirement, last year, of the powerful and most able Finance Minister, Mr. T. V. Soong (the event has never been cleared up, but policy towards Japan is believed to have been the main cause), and the succession of his brother-in-law, Dr. H. H. Kung, can have taken place so smoothly and quietly. Less than a decade ago it might have brought about another civil war. In the bureaucracy, too, one finds a new reality, men who are keen on their jobs and take a pride in getting them done. No doubt there is still much of slackness, fumbling, mistakes, actual dishonesty. But the visible records of the National Economic Council, the new roads, bridges, renovation of old cities, spread of electricity, are proof that there are men in all provinces who mean to get things done. Incidentally, the attention now being paid to the resuscitation of China's peculiar industry, silk, "the royal trade," is particularly welcome. It has lately been stated that Canton is now producing first-class silk cheaper than artificial.

In social affairs the changes wrought in recent years, not only in the treaty ports but in most of the big cities, are enormous. No doubt *mo-têng*—the popular Chinese equivalent for "modern," in the same sense as the Japanese *moga*, or "modern girl"— is responsible for much that is extravagant, laughable, and even mischievous. Yet it has also given birth to wholly welcome ideas

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The Key to Peace or War*

General Smuts Says Anglo-Japanese Alliance was Mistake but Counsels Friendliness with Japan

(Following are the principal parts of an address delivered by General Smuts at a dinner of the Institute of International Affairs in London on November 9.)

* * *

If Europe is to get back to the right road again, it seems to me necessary that the nations, both victors and vanquished, should be cured of their Freudian obsessions, should recover their common-sense and sanity, and should once more see things in their right and normal relations. There is no super-psychoanalyst to do this trick, but it is at least necessary to diagnose the disease, to recognize that it is a disease, and not a healthy normal condition. Once Europeans admit to themselves that they are perhaps a little mad, the cure would come of itself. A sense of humor, of good humor, and a little laughter at themselves will do the rest. "Know thyself" was the wise oracle; "Know thyself" is the word to be spoken to Europe to-day in its temporary obsessions and aberrations. There is no doubt that the present spell will pass, but what irreparable mischief is not being done while it is on! Let statesmen become the courageous doctors to their sick peoples, and the spell will soon pass.

One of the symptoms of this fear complex is the war talk which is now so common. It is represented that we are on the brink of another war, that war is waiting just round the corner. This war talk is creating a war atmosphere, and is more likely to lead to war than anything else. To me it seems all a vicious and dangerous mistake. And the curious thing is that pacifists are most responsible for the scaremongering. In their well-meant efforts to frighten people into disarming and to a sense of dangers to come they are actually fomenting the mentality that leads to war. To me it seems that the only shrewd, wideawake people who indulge in war talk are the manufacturers and vendors of munitions. With all the emphasis at my command, I would call a halt to this war talk as mischievous and dangerous war propaganda.

The expectation of war to-morrow or in the near future is sheer nonsense, and all those who are conversant with affairs know it. Conditions to-day are very different from those of 1914. Then war in the near future was a set policy for which the old Empires were feverishly preparing. They all had their "day" to which the general staffs looked eagerly forward. To-day nobody wants war; every statesman knows it will be the ruin of his country and the end of himself. With perhaps one exception, not a single nation is to-day prepared for war, and war will simply mean internal revolution. And even in the case of the exception I refer to, the people itself is to-day profoundly pacific.

To-day it is not the military but the economic front which dominates the thoughts of statesmen. We are continually being told of what is happening beyond the Rhine, of the secret arming and drilling and preparing. That may be all true, and a great deal of it must be true; but it is probably no more than the workings of the inferiority complex. It is not real militarism, but only military dope applied to the masses. Those wild doings create a blessed sense of satisfaction and relief in those who consider themselves inferior or humiliated by their neighbors on the other side of the Rhine. The real war spirit is another and very different thing. It may possibly revive again if we are unwise enough to let things drift, but for the present it lies buried under the ruins of November 11, 1918. To tell me that the German people really desire war and are deliberately preparing for it is asking me to believe that they are madder than any people could be to-day. Let us stop this senseless war talk, the mischievous tendency of which is to translate itself into fact sooner or later. I do not mean to deny that the times are full of dangers and anxieties, but they do not justify this loose and dangerous war talk and war propaganda.

The League's Task

The remedy for this fear complex is the Freudian way of dragging it out from its hidden depths, bringing it into the open, and exposing it to the light of day. And this is exactly the method of the League of Nations. The League may not be a satisfactory source of security; it may be wanting in that element of sanctions which many consider so necessary. But, at any rate, it is an open forum for discussion among the nations; it is a round table for the statesmen, around which they can ventilate and debate their grievances and viewpoints. The "Open Diplomacy" for which Woodrow Wilson so ardently pleaded is enshrined in the Covenant, and is to-day the settled and accepted method of international intercourse in the League. The League was designed to be first and foremost the round table of the nations, and at that table and in open discussion the secret fear complex can be treated along truly human and scientific lines.

There are those who say that this is not enough—that as long as the League remains merely a talking shop or debating society, and is not furnished with "teeth" or proper sanctions, the sense of insecurity will remain, and the fear complex will continue to dominate international relations. It is also felt that the inability of the League to guarantee the collective system by means of force, if necessary, is discrediting it and leading to its rapid decay. It is said that the crucial case of Manchuokuo has exposed its real weakness and shown that, unless armed with force to carry out its policies, it is doomed. My answer to this is twofold.

In the first place, I cannot visualize the League as a military machine. It was not conceived or built for that purpose, it is not equipped for such functions. And if the attempt were now made to transform it into a military machine, into a system to carry on war for the purpose of preventing or ending war, I think its fate is sealed. I cannot conceive the Dominions remaining in such a League and pledging themselves to fight the wars of the Old World, and if the Dominions leave it, Great Britain is bound to follow.

I cannot conceive anything more calculated to keep the U.S.A. for ever out of the League than its transformation into a fighting machine, pledged to carry out its decisions by force of arms if necessary. And remember, the U.S.A. has still to join the League before it will ever be its real self. Membership of the U.S.A. was the assumption on which the League was founded; defection of the U.S.A. has largely defeated its main objects. And the joining up of the U.S.A. must continue to be the ultimate goal of all true friends of the League and of the cause of peace. A conference room of the nations the U.S.A. can, and eventually will, join; it can never join an international War Office.

Remembering the debates on this point in the League of Nations Commission which drafted the Covenant, I say quite definitely that the very idea of a League of force was negatived there and the League would be false to its great mission as the board of conciliation and settlement for the nations if it ever allowed itself to be turned into something quite different, something just the opposite of its original idea—into a League of force. The solution of the difficulty does not lie in that direction.

The Locarno Plan

But, in the second place, experience since the inception of the League has in fact taught us the way out. Locarno has been incorporated into the League or the collective peace system. And Locarno establishes the principle of limited sanctions, of a smaller group within the League entering into mutual defensive arrangements under the aegis, and subject to the control, of the League. This does not throw the obligation to use force willy nilly on all members, but binds only those who on grounds of their special situation and interests choose to enter into such arrangements. The Eastern Pact or Locarno, which the late M. Barthou proposed for Eastern Europe, as modified by the British Government, would, if it does not miscarry, be another such system of limited sanctions to buttress peace within the League. Its present prospects are somewhat uncertain, but it may be that eventually some such pact or pacts may yet be found feasible in Eastern Europe and in other parts of the world.

**The Japan Advertiser.*

If the fear obsession in Europe can be removed only by sanctions, then let it be on some such limited basis, and within the circumscribed area of those interested, and not by a departure from the principles of universality and conciliation enshrined for ever in the Covenant. To endeavor to cast out the Satan of fear by calling in the Beelzebub of militarism, and militarizing the League itself, would be a senseless, and indeed fatal, proceeding. Whatever forces are used to support peace must be national, and not League, forces, and must be assembled and employed by mutual defence arrangements of those concerned, made under the general supervision and sanction of the League.

I have so far referred only to the fear complex and the way to deal with it. But the other or inferiority complex is very closely associated with it—in the same way that the mentalities of victor and vanquished are closely associated. If we desire peace, it is little use dealing with the one without courageously tackling also the other. It is no use piling up sanctions to remove fear if at the same time we do not strike at the root of the inferiority complex. The fear increases as the inferiority complex becomes more inflamed and threatening. The inferiority complex again becomes more inflamed as the fear complex arms itself with defensive weapons. They reinforce and augment each other, and both together lead to a policy of fresh defensive armaments. Unless both are therefore dealt with we shall continue to keep moving in a vicious circle of the two complexes and of increasing armaments. Unless both the complexes are healed, I fear the policy of disarmament will continue to suffer the reverse which it has so far encountered. It is simply a case of cause and effect. The removal of the inferiority complex from Germany is just as essential to future peace as the removal of fear from the mind of France; and both are essential to an effective disarmament policy.

How can the inferiority complex which is obsessing and, I fear, poisoning the mind, and indeed the very soul, of Germany be removed? There is only one way, and that is, to recognize her complete equality of status with her fellows, and to do so frankly, freely, and unreservedly. That is the only medicine for her disease. And when we have summoned up sufficient courage to treat her in that human way, as our equal in the comity of nations, then, and not till then, will the old wound cease to fester and poison the life of Europe and the world. As long as recognition of her equal position is denied her, the sense of grievance and injury will continue to rankle. This is perfectly human, and it is this human situation which we should face with wisdom and courage.

While one understands and sympathizes with French fears, one cannot but feel for Germany in the position of inferiority in which she still remains 16 years after the conclusion of the War. The continuance of her Versailles status is becoming an offence to the conscience of Europe and a danger to future peace. Surely there is sufficient human fellow-feeling left in Europe to see that the position has become intolerable and a public danger. There is no place in international law for second-rate nations, and least of all should Germany be kept in that position half a generation after the end of the Great War. Fair play, sportsmanship—indeed every standard of private and public life—calls for frank revision of the position. Indeed, ordinary prudence, makes it imperative. Let us break those bonds and set the captive, obsessed soul free in a decent human way; and Europe will reap a rich reward in tranquillity, security and returning prosperity.

Some people consider magnanimity out of place in international affairs. I have seen it in my own country recreate a position of dangerous potentialities into one of everlasting friendship between victor and vanquished. That is the way we humans are built. But if there is no place for magnanimity and generosity in European politics, at any rate here is a case where necessity and prudence point in the same direction and call for the same action. Let us take that action before it is too late.

Cloud in Far East

So far I have confined my remarks to the European situation. Europe, like the poor, is always with us. But in the Far East a cloud is appearing which, although it is at present no greater than a man's hand, may come to overshadow the whole international sky in time. Already on its mere appearance it has severely shaken the League and led to menacing reactions in several directions. People instinctively realize that here is a phenomenon of first-class order, which may have the most far-reaching effects on the fortunes of peace, and indeed of our civilization. Manchuokuo is perhaps not yet the parting of the ways, but it is the warning that we are coming to the parting of the ways and may soon have to make a very solemn choice in national policy.

I have always looked upon the Washington Treaties of 1922 as probably the greatest step forward yet taken since the peace on the road to a stable future world order. In 1921, at the Imperial Conference of that date, I stated my view that a great change was coming over world politics, and that the scene was shifting from the Atlantic to the Pacific. It was felt, and not by me only, that the future of the world would probably be decided, not in the Atlantic, but the Pacific Ocean and countries. The pot might continue to boil in Europe for perhaps another generation, but in the end it would simmer down. Europe would settle her essentially family quarrels in the end, and a state of more or less peaceful equilibrium would be reached. That feeling I have still. But for these tiresome and obstinate neuroses to which I have referred, Europe would probably already be settling down. The storm center will pass away from the countries of Christian civilization and shift to the Far East. There the hand of destiny is still writing in its unknown script—in a language and in ideas which are scarcely intelligible to the Western mind.

Washington and After

The achievement of the Washington Conference was just this—that in this new danger zone of the future a concert or collective system of the Powers concerned had been built up, a loose conference system, founded on certain vital issues, which might do for the Far East what the Geneva League was attempting to do in the West. Comparative naval power, the integrity of China, the open door in that immense potential market, were agreed in principle, and in case of any differences or danger arising the Conference would meet for discussion. Here was the most promising thing for world peace which had yet taken place since the Covenant. The question which is now being raised is whether the promise of Washington will be fulfilled and not prove to be a mere mirage. Manchuokuo, as I said, pointed the danger signal. Now the treaty on naval ratios seems to be in danger; and if that goes the other issues settled at Washington may also be reopened and the whole Pacific concert may collapse. Here is something far more dangerous for the future than these present temporary and passing differences in Europe.

At present we are very much in the dark as to what is actually going on. Conversations are taking place here between the parties to the Four-Power Treaty, the outcome of which is still uncertain. Under these circumstances it would be futile, and may even be harmful, to enter upon a discussion of the merits of the naval questions involved, and I do not propose to do so now, even supposing I had the competence to do so. There is, however, an air of pessimism about the outcome of these conversations which gives food for thought. In view of this, and in view also of the far-reaching issues involved, it may perhaps be permissible to refer to certain broad aspects of the whole question and the fundamental considerations of policy which, I submit, should be steadily borne in mind, without going into the particular naval points which are at present the subject of secret exchanges. I therefore address myself to a few general observations on the underlying policies which strike me as pertinent.

In the first place, this threat to the continuance of the Washington arrangements and the Pacific concert, with all it may ultimately involve, must be another serious call to Europe to put her house in order without undue delay. It must be plain to everybody that the rift in the lute now beginning in the East may have very disturbing effects on the European concert as well. Whereas Europe left to herself may in the end come to some working equilibrium, the new trouble in the East may easily destroy that prospect. Adversity makes strange bedfellows, and those who have in the past talked loudest of the yellow peril may in future be tempted to look for friends in that unlikely quarter. The day when Europe calls in the Far East to redress the balance of the West will be an evil day for Western civilization and the peace of the world. In view of the situation now developing in the Far East European statesmen should redouble their efforts to compose European differences before it is too late. The dangers I allude to are so evident that I need not dilate further on this point.

An Appeal to Japan

In the second place I would appeal most earnestly and in the friendliest spirit to Japan, as our old friend and war-time ally, to pause before she puts in motion machinery which will in the end imperil the concert in the Pacific. She has already given notice of withdrawal from the League. If, in addition, she withdraws from the Washington Treaties the whole collective system goes, so far as she is concerned. For herself this might mean a position of isolation which experience in the Great War has shown to be most dangerous, even for the greatest of military Powers. And for all, the disappearance of the Pacific concert would be a matter of the gravest concern. The collective system is probably the most beneficent of all post-War changes in international affairs, and its weakening or destruction might involve dangers the magnitude of which none can foresee to-day, I therefore pray for the most serious reflection before the final plunge is taken.

In the third place everything possible in the power of diplomacy should be done to avoid even the appearance of antagonism between the East and West. The potentialities of the situation are inherently serious enough, and should not be rendered worse by one-sided diplomacy. Asia is at a curious phase of her awakening. Complexes there, too, are forming. The old exploitation or ascendancy policies are out of place in such a situation, and should be carefully avoided for the future. The past record of the West in the East is not one to be proud of or to be further copied. While mindful of our duty and responsibility as trustees for the greatest civilization that this earth has ever known, we should avoid the assumption of superiority. Not the mailed fist, but the friendly helping hand, should be in future the symbol of our association with Asia.

We are facing the greatest, most intriguing, most testing human situation which has probably ever arisen in history. It may well be that Western civilization will stand or fall in this matter of its contacts with immense human masses of the East. Here let it put its best foot forward and show that it is a universal system, based on the broadest and highest human principles, and not merely a local system for the European peninsula. In this spirit I would say, even if the present negotiations for naval ratios fail, do not let us depart from an attitude of friendliness and large human good will towards Japan. Good will, good temper, friendship, will solve the hardest problems of statesmanship yet. And they are specially called for as the ultimate instruments of diplomacy in our dealings with Asia. If we cannot and should not be allies, we can at least be friends, and proceed to the unknown dangers of the future in a spirit of understanding and friendliness. The old Japanese alliance may have been, and in my opinion was, a mistake. A policy of friendliness and understanding can never be a mistake, and will keep or make friends without thereby making enemies.

Co-operation with U.S.

Fourthly, and subject to what I have just said, I wish to make another point which I consider no less important and vital. This is a difficult world, in which we have to walk warily, in which even good will may not be enough and in which we are called upon to exercise a wise discretion as an insurance for the future. In this spirit I would say that to me the future policy and association of our great British Commonwealth lie more with the U.S.A. than with any other group in the world. If ever there comes a parting of the ways, if ever in the crises of the future we are called upon to make a choice, that, it seems to me, should be the company we should prefer to walk with and march with to the unknown future. On that path lie our past affiliations, our common moral outlook, our hopes and fears for the future of our common civilization. Nobody can forecast the outcome of the stormy era of history on which we are now probably entering. Our best insurance in this unknown territory is to be with those with whom we have an instinctive and historic sympathy.

The British Commonwealth has its feet in both worlds. Through Great Britain its one foot is firmly planted on this old continent. Through the Dominions it has its other foot as firmly planted in the outer new world, where the U.S.A. already plays so great a part. The Dominions have even stronger affiliations towards the U.S.A. than Great Britain has. There is a community of outlook, of interests, and perhaps of ultimate destiny between the Dominions and the U.S.A., which in essence is only the first and most important of them. Through the Dominions British policy is ultimately tied up with the U.S.A. in a very profound sense, which goes much deeper than the occasional jars which, perhaps, are more acutely felt at any particular moment. That fundamental affinity, coming from the past, stretching to the future, is, or must be, the real foundation of all British foreign policy. Any policy which ignores it, or runs counter to it, is calculated to have a disruptive effect on the Commonwealth as a whole. We are here on bedrock, which we ignore at our peril.

While therefore our Far Eastern policy should, I submit, be based on friendship with all, and exclusive alliances or understandings with none, the ultimate objectives of that policy should continue to conform to that general American orientation which has distinguished it since our association with the U.S.A. in the Great War. In this way our policy will correspond to the actual general situation of our Commonwealth in the world of to-day—a situation which goes much deeper than, and underlies, all public policies, and on which alone it is possible to base stable and enduring policies for the future. Any other course would mean building our Commonwealth policy on quicksands, and placing the future of this group at the mercy of incalculable accidents.

Signs of Better Days in China

(Continued from page 531)

of health, initiative, and energy. The growing popularity of athletics in all provinces is really extraordinary. Part of Nanking's equipment is a vast stadium capable of seating 70,000 people (another, like it, is being built at Shanghai), and here periodically many hundreds of youths and girls, the pick of thousands of others in distant provinces, meet for athletic contests of all kinds, and show no small prowess and abundant sportsmanship.

One extremely interesting movement, founded by General Chiang Kai-shek is known as the "New Life" movement. The important feature in it is that it is not confined to schools and colleges, but goes right down into the village. It might be described as a compound of the manners that maketh man and the cleanliness akin to Godliness, with the ultimate object of moral and physical betterment. Its rules are few and simple, and by all accounts it has caught public fancy amazingly.

And herein one sees a definite attempt to supply China with a new ethic, which indeed has obvious connections with a very old one. The most momentous change in China's recent history was not the overthrow of the Emperors, but, six years earlier, the rejection of the classics for public education and the substitution of western learning, whereby the youth of China were deprived of the all-pervading ethical training in which the classics are steeped, while nothing was given them in its stead. Here is the great deficiency of China which must be made good. That it will be there can be no doubt, though how has not yet been revealed. Many experienced observers believe that there will be a return to Confucius. Again and again he has been temporarily eclipsed by the rival popularity of Taoism or Buddhism, yet always he has returned to his own. It is immensely significant that in 1929 when the Kuomintang, then at the height of their power, tried to seize the Kung family estates ("Kung Fu-tzu" is the Chinese form of "Confucius") the nation rose as one man and refused to allow it. Already here and there one reads of a revival of Confucian study, even in Canton. It would have to be a modified Confucianism. The tremendous implications of the central virtue of "filial piety," so far beyond what the West understands by the phrase, which indeed are in some ways as cramping as they are far-reaching, would have to be relaxed. But there is that in the teachings of the Sage which has grown into the very fibre of the Chinese nature, which realizes for them the best ideals of a gentleman as no other teaching has ever done, and from which they will not forever be parted.

Mukden Has Record Year

MUKDEN, the industrial capital of Manchuria has received from civic authorities a survey of its constructional expansion for the building year ending October 31, from the previous November 1, showing an unprecedented growth in terms of dollars, the value of new building being more than 22 million yuan.

More than 19 million was spent in buildings, and three millions in roads and essential services. Never in the history of Mukden has such activity been recorded, and the reaction on local trade and commerce has been equally important, with labor prospering to a very high degree. Thousands of workmen were attracted to the city and are still hard at work carrying out inside construction work as contractors hurriedly complete exterior walls and roofs before the permanent frost.

Most of the expansion was to government account, the biggest single producer being the State Direction of Railways with six million dollars' worth of new building, especially on its new home offices. Principal items in the list of achievements this year are :—

Builders	*Roads*	*Building*	*Total*
The Kwantung Army Yen or MYen ..	80,070.00	1,625,108.00	1,705,178.00
Kwantung Government	—	158,310.00	158,310.00
Bureau of Commerce ..	111,097.00	41,762.11	152,859.11
Municipality	141,619.93	67,679.00	211,298.93
Bureau of Roads ..	1,035,508.00	—	1,035,508.00
S.M.R.	412,396.20	823,605.00	1,236,541.20
S.M.R. Ry. Construction	250,830.90	299,997.22	550,828.12
Gen. Direction State Rys.	672,987.47	5,944,178.59	6,617,166.06
Fengtien Ry. Bureau ..	487.218.10	362,205.88	849,486.07
Other Govt. Bureaux ..	19,049.52	2,135,773.41	2,154,822.93
Private Buildings. ..	—	6,680,323.00	6,680,323.00
Manufacturing. Concerns	—	1,040,860.00	1,040,860.00
Total	3,211,375.21	19,181,800.21	22,393,175.42

The rate of growth may best be shown by comparison with the previous twelve months when a mere $720,000 was spent for building and $800,000 on road construction.

It was a magnificent year for labor, as money flowed out to thousands of families, and making for widespread prosperity.

Japanese Experts

Though it is impossible to get exact figures for the total of the laborers employed according to a gross estimate it has been between 22,000 to 25,000, daily showing 42 to 50 per cent increase, compared with the last year. About three per cent of the laborers were Japanese, 0.5 per cent Koreans, the rest were Manchus and Chinese. There were difficulties in obtaining specialists for different kinds of construction work, and in some instances trained Japanese experts had to be brought from Japan. Thus, thirty expert plasterers had to be imported from Osaka district.

Mukden Wages

Wages in Mukden during this year were as follows in yen :—

	Japanese	*Chinese*
Coolies	3	0.80
Specialist	3.30	1.40
Blacksmith	3.50—4	1.20—1.60
Plasterer	3.20—4	1.70—2.50
Painter	3.00—3.50	1.20—1.60
Sawyer	———	1.20—1.60
Carpenter	3 —4	1 —1.60
Mason	4	1 —1.80
Bricklayer	4	1.40—1.60
Tatami maker	3 —4	
Furniture maker	3 —4	1.30—1.70
Screen maker	3 —4	1.30—1.70
Roofer	3 —4	1.30—1.80

	Japanese	*Chinese*
Glazier	3 —4	1.20—1.60
Tinsmith	3 —4	1.20—1.60
Tool maker	3 —4	1.20—1.60

The cost of a motor truck per day was Y.20, and a horse or mule cart Y.2.50, that with two horses Y.3.50.

Materials Demanded

Most of the bricks used for construction were made by local factories, the manufacturing capacity of which is estimated at about 120,000,000 pieces. However, on account of unfavorable weather they were unable to meet the demand which amounted this year to 150,000,000 bricks. Due to big demand and high cost of delivery the price which formerly was one cent a brick went up to 1½ cents.

There have been three different sources of cement supply. The military authorities have had a special contract with a company at Hsinking, and the S.M.R. has had a contract with a firm in Dairen. Both are directly controlled by the government. The demand for private construction, amounting to 600 carloads per month (one carload contains 598 sacks) has been supplied by the Onoda Cement Company.

Some 4,000 carloads (one carload contains 33 cubic meters) of timber were imported to Mukden during this year, indicating an increase from 30 to 40 per cent as compared with the previous year.

There is no definite figure obtainable to the amount of steel used during this year, but according to reports which were received there have been considerable difficulties in getting a sufficient supply of steel here : This has been due to the recent storm which swept Japan, and might be illustrated by the fact that since the end of September the local price of steel has risen by about 82 to 90 per cent.—*The Manchuria Daily News.*

Communications in Manchuria

An agreement has been signed between Manchoukuo and Japan whereby all electrical communications in the Kuantung Leased Territory, the South Manchuria Railway zone and the rest of Manchoukuo are brought under joint Japanese-Manchoukuo control. It has been decided that 1,000,000 shares of the Manchuria Telegraph and Telephone Company to be established will be divided into three groups, namely, 120,000 shares to be subscribed by the Manchoukuo Government, 330,000 shares by Japanese Government, and 550,000 shares offered to public subscriptions. Large private subscribes scribers already selected are the South Manchuria Railway Company, to subscribe 100,000 shares, the Manchoukuo Central Bank 50,000 shares, the Mitsui, Mitsubishi, Sumitomo and large financing houses in Japan, the Japan Radio Broadcasting Association and others 300,000 shares in all, and the remaining 100,000 shares to the general public.

Japanese Scrap Imports

In a special circular the Baltic and International Maritime Conference states :—" There has been an increase in the shipment of scrap-iron cargoes to Japan recently, and it is expected that there will be further imports of scrap. These cargoes mostly come from America, and are destined for the Yawata Ironworks, Yawata, belonging to the Japanese Government. Yawata is situated about nine nautical miles west of Moji, and is a comparatively primitive port where only scrap, ore and coal are discharged for the ironworks. Hitherto the despatch has been fairly good, but, owing to the increase in imports, congestion has arisen, and is likely to continue in the circumstances. The maximum scrap that can be handled by the ironworks is about 150 trucks daily, with five to 600 coolies. On the basis of actual experience during July, it would require about one week's stay to discharge about 2,300 tons."—*Iron and Coal Trades Review.*

Coming of the Power Era*

New Engineering Building Is Opened at the University of Hongkong

By Professor C. A. MIDDLETON SMITH, Dean of the Faculty of Engineering at the University of Hongkong

DECEMBER 7, the Chancellor of the University of Hongkong, H.E. Sir William Peel, will officially open the latest of the many new buildings which have been erected during the 22 years since students were first admitted in October, 1912. The new building has been named after the Chancellor. It is called "The Peel Engineering Laboratory."

Inscribed on the front wall below the name given above is quotation from the Book of Odes, written many centuries ago. The quotation is given in Chinese characters and in English words.

As usually happens, the sinologues could not agree concerning the translation from the old Chinese characters into the English language. Various versions were suggested. That which appears on the outer wall of the new building reads as follows :—

"Water and Fire, Metal and Wood, Earth and Grain : Here is Progress ; Propriety of Conduct. Convenience to Mankind. Plenty in Sustenance. Here is Harmony."

It is of interest to note that in the Charter granted to the (British) Institution of Civil Engineers, rather more than a hundred years ago, engineering is defined as the endeavor to utilize the forces of Nature for the use and convenience of mankind.

The new building will be used by all engineering students of the University for practical experience and instruction in power production. That is the basis of western civilization. It is being adopted in China, not as rapidly as some of us desire ; although in Shanghai, Hongkong and other places very efficient power generating plants are at work and every advantage is taken of the facilities supplied by electricity production and distribution.

As this new laboratory may be regarded as a center of instruction in power production and is, indeed a power station, it is of interest to discuss the effect of this important foundation of modern technology viz : the production of electric power upon China.

The Latest Record

The dream of conquering nature has been one of the oldest that has stimulated man into activity. The fire-bringer, Prometheus, was the first hero of the struggle which still goes on : the last is the designer of the "Comet" flying machine that startled the world with an almost incredible performance in the London to Melbourne air race.

The fire of Prometheus heralded the dawn of civilization. The white-hot flames within the quivering cylinders of the "Comet's" engines were the triumph of the new power era. For the heat of those flames catapulted Scott and Black through space at a speed beyond the wildest dreams of even this generation. Equally wonderful were two other manifestations of tamed energy. News of their achievement was received by wireless in homes all over the planet within a period of minutes of their success. A photograph taken in Melbourne was sent 11,000 miles by beam radio and reproduced in a London newspaper 24 hours after the shutter of the camera had clicked in the antipodes.

Story of the Conquest

The first uses of fire were for making food easier of digestion, for warmth in the colder season, for the beginnings of social life in place of the loneliness of the isolated family unit. Terrifying and predatory animals were frightened and kept off by the red flames. And then, very slowly came the conquest of human environment by the improvements in tools and weapons and utensils. Fire-making, agriculture, pottery and astronomical observations marked the slow and painful steps in the upward climb to knowledge that was man's great endeavor as soon as he came down from the trees and became, by craftsmanship, truly separate from the animal world.

Always there was the dream of some greater conquest of nature, the hope of a reversal of dependency upon merciless and external forces which, in a childish fear, were represented as gods. The myths, the sacrifices, the fairy stories are nothing but testimonies of the human longing for length of days and freedom of movement.

The flying carpet of the Arabian Nights, and the seven-leagued boots, were the vain dreams created by a desire to diminish space. Astarte and Pysche in Europe, the flying man of the Peruvian Indians, the mythology of ancient Egypt, even the Angels of Christianity, convince us that the dreams stimulating these pictures also produced a realization of the difficulties of transforming the desires into actual fact. And so in the early days of human history the more audacious dreamers promised to the credulous magic as a short cut to knowledge and power.

Science and Technics Bring Power

Then, at last, came the age of machinery. Steam engines displaced horse-power, iron and concrete displaced wood, and greatest triumph of all, Faraday in London demonstrated the simple method of producing, by a machine, the mysterious but priceless fluid energy that we speak of as electric power.

Two of the greatest landmarks in human history are associated with the names of Watt and Faraday. The former proved the commercial value of changing the chemical energy of fuel into mechanical energy that would do work. The latter showed that mechanical energy can be transformed into electricity, a more convenient and easily transmitted form of power.

Although the history of the new civilization commenced with Watt's great imaginative fertility, yet his was not the first mind to ponder over the possibility of substituting steam power for muscular energy. And others had produced electricity by friction and chemicals before Faraday made his elementary dynamo. Great inventions are never, and great discoveries are seldom, the work of only one mind. Watt and Faraday made dramatic leaps forward, but their efforts were but the more spectacular movements in a progression that had been going on through the ages. For a great invention is not a sudden creation—it is a growth just like the trees of the forest. And as after slow growth, nature suddenly produces in her vegetation beautiful foliage or flowers so does the human mind complete the growth of ideas and make serviceable some great and even beautiful invention.

Dr. Hu Shih's Verdict

So profound have been the results of Watt's commercial success with the steam engine upon mankind that human history can be considered as being divided into two eras—the pre-power era and the post-power era.

Developing slowly at first, the new civilization has come, at last and in very recent years, to Asia. "It was," says the Chinese scholar, Hu Shih, "Science and the new technology which restored to man the sense of self-confidence and created the modern civilization of the West. It was the introduction of science and technology which transformed Japan and built up her modern civilization. And it will be the same science and technology which will transform the whole East and bring China and India into the world of modern civilization."

The majority of mankind have wanted, always, only to be happy in a simple, human way. Their constant hope and prayer has been for health, food and the family. But all through the drama of tangled history man has been faced with awkward difficulties. We can hardly expect that we, of this generation,

* *The North-China Daily News*

shall be relieved of problems that urgently demand solution. But the lesson of world history is that man's conquests have been due to his adeptness in adjusting himself to changing conditions. We have no reason to fear failure in this age of greater knowledge.

What to Do?

It was noticed that when two men met in China the salutation was "Have you eaten rice?" In England the first words, under similar conditions, were "How do you do?" In the one case there was on implied curiosity about the satisfaction of hunger; in the other an interest in doing. As soon as the pangs of hunger are regularly satisfied men want to *do*. Only a very limited number, however, possess initiative. And very few can plan intelligently.

Most men want to be told what to do—not what to think. For thinking is difficult, especially if one is wearied with the struggle for existence. If there is leisure, then there is time to think: unless as is so often the case, leisure is frittered away. It is only by thought that we can develop to the full the possibilities of the human mind. Ignorant critics of technology, such as Gandhi in the East, and certain superior writers of the West, ignorant of elementary knowledge of any science, blame the engineers for neglecting the higher values of life. They say that science is concerned only with materialism. Out of the Far East has come the answer to those pessimists and it comes from a famous classical scholar. Dr. Hu Shih claims spirituality for the technological phase of modern Western civilization. "Modern technology," he writes, "is highly spiritual because it seeks, through human ingenuity and intelligence, to relieve human energy from the unnecessary hardships of life and provide it with the necessary conditions for the enjoyment of life. Whatever be the use man may make of the resultant comfort and leisure, the relief of suffering and hardship is itself spiritual."

The Path to Progress

Let us suppose that every one of the 400 millions in China were to wake up to-morrow with 40-times the energy that he or she had on retiring to sleep to-night. The farmer could plough or reap 40 times as much, the carpenter fashion into shape 40 times the quantity of wood, the housewife enormously multiply her limited leisure. Houses would soon replace hovels, every man would have a coat, every woman the decorative clothing she adores. Roads and bridges would rapidly be built, strong dikes would defeat the grim dragons of the floods. The conquest of poverty in China would soon be complete.

That multiplied energy is exactly what every inhabitant of England on the average has available to-day. The electric grid and other sources of power provide 40 times the muscular energy of the population of England.

It is true that not every person reaps the full benefit. England is still "muddling through" (as is North America, Europe and Japan) to economic efficiency. In a broadcast all over England the Prince of Wales, who had visited the slums and the black mining areas, pleaded the cause of those crushed in spirit by their surroundings. He said: "I am appalled that such conditions can exist in a civilized country such as ours." The disease has been diagnosed by the highest in the land. The remedy is being planned.

Improvements have taken place. In England in my life-time the power era has made possible national insurance, a dramatic increase in the average length of life, food and luxuries brought from the ends of the earth, recreations such as are provided by broadcasting and the talkies, while education is made easy for all of the children and for many adults.

Nobody who has studied the problem can doubt that the most urgent need in China to-day is the efficient development of the natural resources of the country. All over the world there are many examples of how that can best be accomplished. In the main it must be done by the Chinese people, but they cannot expect to do entirely without advice and assistance from others. Experience is invaluable in applied science work.

As in England, and other westernized countries so in this other little island in the Far East, we have been making use of applied science to improve conditions of life. The latest manifestation of technology is the new giant building being erected for the Hongkong and Shanghai Bank. Chromador steel, used for the first time in history for the framework of a huge structure, is vastly superior to the mild steel that, in its time, was so much better than the materials it displaced.

Concrete mixing machinery, compressed air drills, slim crane arms outlined against the sky, electrically operated pumps and night illumination of many thousands of candle power enable the activity of the builders to be ceaseless. All of these things convince us that the power era has come to Hongkong. And if you would see another example, go out to the Shing Mun Valley, where an enormous dam of concrete and granite blocks is rapidly taking shape. There you will find the silence of countless centuries in that once lonely valley broken by the rattle and whirl of modern machinery. Time is now a factor to be considered on such works, even in China. For although labor is cheap, money is scarce, and if time is saved money is saved also.

"Muddling Through"

As in England, during the last century, so in Hongkong, the planning of the use of power has been less efficient than the planning of the improvements in machines which have made possible such a great reduction in the selling price of power.

There has been ample evidence of human inertia, of the triumph of the back pullers, the opponents of all change, "Can do" frequently has been at the back of the minds of many of the leaders of the community in Hongkong. Europeans, as well as Chinese, cling like limpets to "old custom"; and so, in Hongkong, as elsewhere all over the world, we have been since the coming of the power era, more or less "muddling through." Very few people in the place had any knowledge of applied science, and nearly everyone had the vaguest ideas about the rapidity of the new methods of mass production. It is not improbable that some suffered from easy prosperity in the trade "boom" at the end of the war. The pinch of prosperity often produces mental inertia.

In the past there has been ample evidence of things left undone that should have been done in Hongkong. Lack of pre-vision concerning water supply placed the name of Hongkong in the headlines of newspapers in England and America. It is almost incredible that the 22 mile road round the island was not completed until 1920.

It is a noticeable fact that the majority of men require to be propelled from the rear by the jabs of necessity although there have usually at the same time, been some pulls from the front. It requires courage to suggest a radical change from the old routine.

A Remarkable History

And yet those of us who know the history of Hongkong can feel a just pride in what has been accomplished.

The little island that was barren and the home of only 5,000 people—mostly pirates—less than 100 years ago has now, with the new mushroom city of Kowloon across the harbor, nearly a million inhabitants. Where there was sudden and mysterious death amongst Europeans in the early days there is now an astonishingly low mortality record. For all the claims made on behalf of others, it must be remembered that it was Dr. (afterwards Sir) Patrick Manson who proved that malaria was not due to a misty dampness from the earth, but to the mosquitoes that bred rapidly in small patches of water. And the discovery that the dreaded plague was caused by fleas from rats quickly led to the elimination of that enemy of life.

Perhaps the greatest triumph of the local administration has been the almost complete freedom of Hongkong from public debt. There is probably no other place in the world in such a fortunate condition to-day with regard to Government and/or municipal indebtedness. As against that is past delay in carrying out urgently needed public works and social reforms. Especially undesirable is the overcrowding in certain sections of the City of Victoria. There is yet much to be done in Hongkong to improve housing and the condition of the laboring classes although there never was so much social service as to-day.

The most encouraging sign of recent years has been the great extension of interest and voluntary services of educated women in this charitable work. And Hongkong has gained a reputation as a center of education. It is also noticeable that people now visit it in winter for its attractive general living conditions at that time of year.

In a friendly interview with Dr. Sun Yat-sen, some years ago, that hero of the Chinese people broke off from a series of bitter complaints about the lack of support from the British Imperial Government, and paid a tribute to his old teachers in Hongkong. He also expressed gratitude for the examples of Western civilization available at this gate of China.

The latest effort in Hongkong to help the Chinese to develop the natural sources of energy in their own country is the construction of the Peel Engineering Laboratory in the local University. The building has a total of 18,000 square feet of available floor area. It will be used mainly for instruction and in demonstration of modern methods of power production. Engines will change the heat carried in the steam from the furnaces of boilers into useful work. And as in the University laboratories the furnace roar, steam and water turbines whirl, oil engines of great variety drive dynamos, or demonstrate easily the basic principles upon which they operate, students will handle and understand the intricacies of these machines.

Humidity and the Comfort Zone

Even the mechanical production of cold, that great gift to man in the tropics, is proved and explained as the water changes into ice before the onlooker's eyes. And it is planned to experiment with, as well as to explain, the methods of air-conditioning which enables us to squeeze moisture out of the humid atmosphere of the tropics as water is squeezed by hand out of a sponge. Every new dwelling of importance in Hongkong, in the near future, will be designed so that the occupants may breathe air that is within a perpetual comfort zone.

Adjoining the Peel Engineering laboratory, of like appearance and equal size, is the Ho Tung engineering workshop, where, during the past ten years all engineering students in the University have gained much practical experience in handling machine tools of great variety. A number of lathes, drills, planing machines, etc., are installed. In many cases each is equipped with a separate electric motor and the power used in certain operations is recorded by electrical instruments. There is nothing vague or uncertain about the measurements or the methods in the Ho Tung Workshop. Micrometers ensure accuracy to within a ten-thousandth part of an inch. In the laboratory for testing materials of construction (such as cement, concrete, timber, steel, etc.) even finer measurements are made. One of the most important features of Western civilization is accuracy of measurement.

Each of the two buildings mentioned above covers a land area of 10,000 square feet. Plans have been prepared to fill in the area between them, which is 20,000 square feet, with a building which will have one storey higher than the existing buildings. At present other engineering laboratories—testing of materials, hydraulics, electrical machinery, etc., are housed in the main buildings of the University. The Peel and the Ho Tung buildings each cost nearly $100,000. It is estimated that about $200,000 will be required for additional engineering buildings.

Practical Chinese Engineers

More spacious laboratories have been essential because of the increase in the number of enginereing students and because of the expanding equipment. Engineering is a progressive science and each year additions have been made to demonstrate new methods employed in practice.

It may be of interest to those readers who cling to the old ideas about unchanging China to state that we have proved false the oft-repeated statement that Chinese students will not dirty their hands.

That may have been true of the educated classes of the past in the old days when the length of finger nails was a sign in China of the contempt for manual labor. It has always been difficult for the writer to reconcile that curious fashion of long finger nails with the ritual of an Emperor giving an annual example of handiwork when he ploughed the earth. But the long finger nails and the theatrical exhibition by an Emperor are now in the limbo of Far Eastern history. Chinese students now take as readily to workshop and other practical work as do English students, if they receive proper instruction. For expensive equipment and palatial buildings are wasted unless there are intelligent and patient instructors.

The Dreams of Youth

The story of the growth of the University of Hongkong is one of early difficulties and unexpected aid given at critical moments. The father of the scheme was Sir Frederick (now Lord) Lugard who, it is said, was inspired by his wife. The latter was, before her marriage, a famous journalist named Miss Flora Shaw. She was an intimate friend of Joseph Chamberlain. It was probably her close association with that statesman—the father of the first of the civic Universities in England (Birmingham)—and her knowledge of the great success of his courageous experiment, that made her ponder over the idea of a University of Hongkong.

The Lugards had enormous enthusiasm for the new scheme; whether they underestimated the great expense of a University that was intended to train students in engineering, medicine and other scientific subjects, or whether they deliberately left difficult financial problems for their successors, is not at all clear. It is probable that the lack of experience in University administration made them underestimate the cost and their delightful optimism made them sanguine of the success of the scheme if only it could be started.

When the University buildings were designed an area of 600 square feet was provided for an engineering laboratory. On my voyage out to Hongkong from London visions of spacious buildings and fine equipment filled my mind. On arrival it soon became evident that such visions were like a mirage. They have now, to a great extent, come true. The floor area of the laboratories and workshops used by engineering students now is 54,000 square feet. The equipment is thoroughly up-to-date.

The undersized infant of the Lugards had grown out of all recognition. In the place of the one Professor of the first year of the University there are now fifteen. The European staff numbers about 30 and there are a large number of Chinese assistants.

In addition to the original buildings opened in 1912, Hongkong $1,500,000 have been spent on new buildings. The total annual revenue is more than twelve times what it was in 1912.

The Value of the Degree

When the appeal for endowments was first launched it was stated that the endeavor would be made in Hongkong to provide the same type of instruction as in the University of London. The policy of the Board of Faculty of Engineering has always been to place beyond dispute the status of the degree awarded. Therefore, every year since the professional examinations have been held the papers have been sent to London Assessors who are also examiners in these professional subjects in the University of London. And it is notable that every year those London Assessors have awarded to Hongkong candidates Honors Degrees in Engineering, with a certificate stating that the Hongkong graduates have attained the same standard as the Honors graduates in engineering in the University of London.

Owing to the fact that the development of engineering work in China is less advanced than in England, very much more attention and time is devoted in Hongkong to practical instruction in the workshops and engineering laboratories. Students are encouraged to spend the whole, or part, of their vacations in gaining experience in the handling and testing of machinery.

The Ideal Scheme

Thoughtful friends of the Chinese realize that it is not expedient to send a boy direct from school abroad for a University training. Chinese students in Hongkong reside in the University, mix socially with the local community, play games, and generally become accustomed to Western civilization without an abrupt severance from their own people.

After their experience in Hongkong they have greatly improved their knowledge of the English language and of the ways of life in the West.

Those graduates who can afford to do so are advised to spend a year or more abroad. Several engineering graduates have taken higher degrees in England. Some have taken post-graduate courses in such specialized subjects as reinforced concrete design, water supply, architecture, etc., others have gained further practical experience under commercial conditions in industrial establishments.

(*Continued on page 546*)

Water Supply in Hongkong

The Story of a Triumph of Applied Science

By *Professor C. A. MIDDLETON SMITH, M.Sc., M.I.Mech.E. (Dean of the Faculty of Engineering in the University of Hongkong)*

PART VI—PROBLEMS FOR CHINA CONCERNING THE UTILIZATION AND CONTROL OF WATER

In the five previous issues of this journal detailed accounts of the different schemes carried out in Hongkong, with the object of ensuring a constant supply of pure water for the residents, have been described.

It is now proposed to discuss the various problems connected with water supply, particularly in connection with the experiences that have been gained in many parts of the world (including Hongkong) and which should be of great value to those who will deal with such matters in China.

Anyone who considers the subject, and who takes into account the difficulties caused by local conditions, will agree that the engineers in Hongkong responsible have done their work efficiently. The benefits to the community resulting from their efforts have more than justified the expenditure of public funds. And the same results can be obtained in other parts of China.

It may be mentioned that, in contrast with the system employed in Hongkong, Shanghai obtains water from the river : an enormous quantity of unpleasant and undrinkable water is taken out of the stream and is chemically treated and purified. So that Shanghai obtains an ample supply of pure water. The source of supply never fails and Shanghai has been spared the restrictions, the panics and the perils that Hongkong has experienced in recent years on account of water shortage.

Mention must be made of the recent endeavors in South China, notably Canton and Wuchow, to install a modern system of water supply. During the last decade there have been many schemes outlined for the supply of water to Wuchang, a city of 300,000 inhabitants. All that can be said is that the first stage of the plan for supplying pure water was completed in June 1933. The supply is about one million gallons (U.S.A. gallons). House connections are not yet available and water is distributed by carriers at a rate of 60 cents a month per hundred catties a day. It is a commencement and no doubt extensions will soon be made. There can be no doubt that those excellent examples of water supply to cities in China will be followed to the great benefit of the community.

Expert Advice

If we come to examine carefully the history of Hongkong we shall be struck by the fact that, even in the early days, great care was taken to obtain the best expert advice. Consulting engineers, with long experience of water supply systems all over the world, were invited to examine local conditions and to advise as to the best methods of ensuring adequate storage.

In connection with the development of catchment areas, etc., in the Tytam district, a complete scheme for several reservoirs was outlined, and although the work was done in stages at different periods, yet it was all part of one big scheme.

When it became obvious that there were no more catchment areas available on the island, Mr. Henderson spent a great deal of time and energy in exploring other parts of the Colony with the object of formulating other schemes that could be developed as the need arose. He had previously spent more than twenty years is gaining experience as a specialist in water supply. He finally recommended that the huge area round about the Shing Mun Valley be used to supply the much needed supply of water.

London consulting engineers were requested to examine and report on Mr. Henderson's proposals. The great dam at Shing Mun was designed by the firm of consulting engineers in London who are the recognized specialist on the subject.

Water Supply in China

It is obvious that the engineering problems connected with water in China are many and various. We have been concerned in this series with the supply of drinking water in Hongkong and all the cities of China need to have a proper and modern system. But there are also the urgent problems of flood prevention, irrigation, canals and harbor works. It is obvious that there is enough civil engineering work in China, that needs to be put in hand at once, to employ thousands of Chinese engineers and many hundreds of thousands of workmen.

If any of these schemes are to be carried out efficiently it is most essential that they should be planned properly. And therefore the very best advice available in Europe or America should be obtained. The details of the work can be carried out by Chinese engineers, but there are not at present, as far as the writer is aware, any Chinese engineers with sufficient experience of big engineering works to advise on important problems connected with water supply, irrigation, etc.

The Transformation of Asia

Make no mistake about it, Hongkong has had a profound effect upon the Far East. This is, in truth, the Island of Romance. In 1841 a barren island, the home of about 5,000 lawless pirates, the terror of the China Seas, Hongkong is now one of the most verdant places on the earth with its tree-clad hills and its non-indigenous flowers that flourish in this tropical climate.

It has grown to be one of the greatest ports of the world, with about a million inhabitants. Its fine roads, its many reclamations, its efficient medical and sanitary services, its magnificent buildings and public works, the even justice of its law courts, its benevolent government, and its many charities and social services, as well as its educational system that culminates in a local University, entitles it to that proud title, given to it by a prominent Chinese, who called it a "Lighthouse off the Coast of China."

The story of the water supply was given in detail in the hope that a practical example of the splendid work in that branch of engineering might be a stimulus to the authorities who are moulding the destiny of China. Let us trust that they will insist upon public works being carried out as quickly as possible.

All over Asia engineers are employed utilizing the forces of Nature for the benefit of humanity. Probably the greatest examples are to be seen in India, where, for about a hundred years, large works connected with irrigation, transport, etc., have been completed. At present many huge schemes have been planned, some of which are in the course of construction.

Lessons from India

Having had the opportunity to study many of the schemes for irrigation, hydro-electric power, water supply, etc., that have been carried out in India, and having travelled thousands of miles in China, the writer is struck by the close resemblance of the engineering problems in the two countries.

It therefore seems reasonable to suppose that engineers who have successfully carried out some of the magnificent works in India would be able most suitably to advise upon, and supervise, similar schemes in China. It may be mentioned that Sir Richard Dane, who so successfully reorganized the Salt Gabelle in China, attributed much of his success to long experience on similar work in India.

In the beginning of the great changes in Japan, due to the introduction of applied science to that country, advice was sought from engineers who had had valuable experience in connection with water supply problems in India.

The Engineer as Civilizer

In that connection it is of interest to record some remarks made in 1890 by General Scott—an officer in the Royal Engineers—

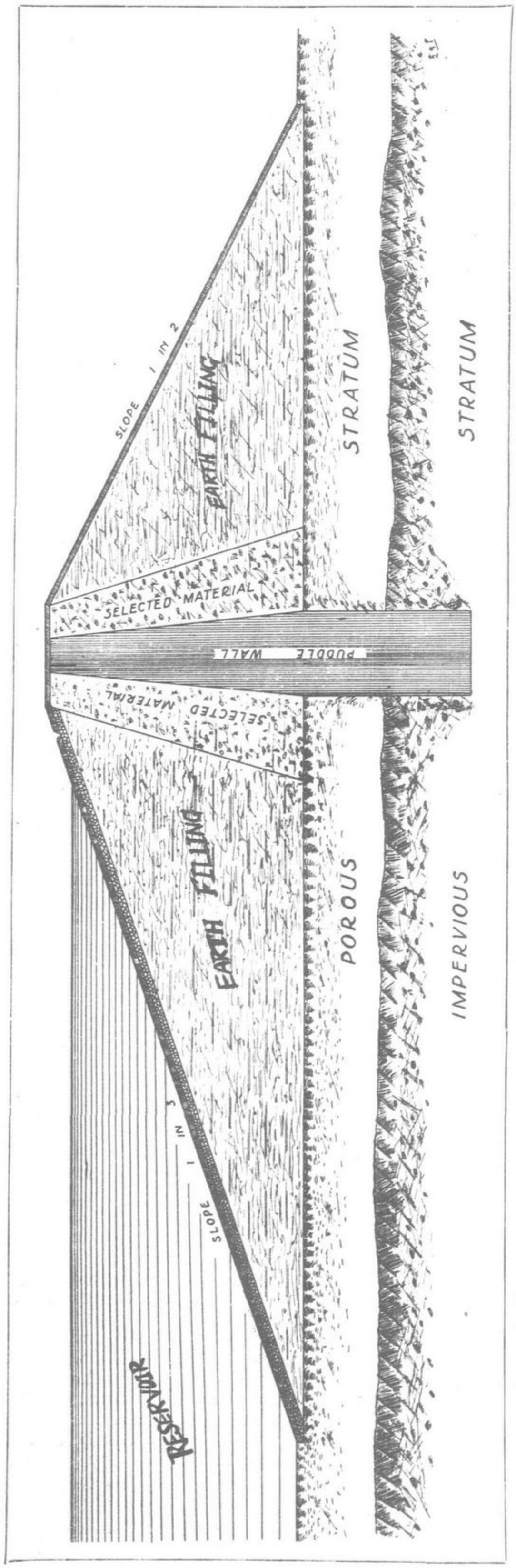


Fig. 1.—Section of Earthwork Dam. This shows the Central Puddle Wall to prevent leakage of water. Earth filling is a cheap method of construction

during a discussion in London concerning waterworks in China and Japan. He suggested that the problems concerning the supply of water in those countries were of special interest to all engineers, due to the localities affected by their solution. It was at a time when engineering was in its infancy in the Far East and British engineers were then engaged in the pioneer work.

Technical descriptions of waterworks in Hongkong, Shanghai and Yokohama were read before the Institution of Civil Engineers in 1890 in London. There was an animated discussion and those who took part in it were anxious that modern water supply systems should become general in the Far East, if only on humanitarian grounds.

"They stood" said General Scott on that occasion "as it were, on the fringe of countries which had been in the highest degree exclusive, and the inhabitants of which had repelled for hundreds of years, and successfully repelled, the efforts made by European nations to extend their intercourse over the interior. Diplomatists had tried to find the 'open sesame' which would unlock the door shut in their faces. They had only succeeded in opening some few ports to trade." "Merchants had tried their hand, but the literati and mandarins despised trade, and progress towards the interior had been arrested. Missionaries had been at work for centuries; but they had not yet induced the Chinese to warm to foreigners, and for political reasons they were disliked by the officials."

Oriental Ethics and Engineers

To his mind it was the engineer who stood the best chance of breaking through the crust of prejudice, distrust, and dislike, which still formed a barrier to intercourse with Europeans, and to the material progress of those countries. He stood before those people as the creator by his skill and knowledge of works which, by the benefits they conferred on communities, were humanitarian in their scope and intention. The very ethics of the people were in his favor. The pious Oriental, who wished to secure his own happy transmigration, commonly planted a grove to shade the wayfarer, or built a road or bridge to aid his progress. He dug a well or a tank for irrigation and the production of food, and not seldom was the Government engineer in India called in to give shape to those good works. In the cases under consideration, Orientals at Hongkong, Shanghai, and Yokohama were enjoying the benefits of the European system of water distribution. Each one of them was an agent, more or less active, in disseminating a knowledge of the advantages which he enjoyed.

Those words explain clearly why many of the Anglo-Saxons who know the Far East believe so firmly that the best method of improving the condition of the people is to develope the natural resources of the country.

General Scott fully believed that before very long there would set in a current of Chinese opinion in favor of the European engineer and his methods, and that members of the engineering profession, would find in those countries vast opportunities for the exercise of their abilities. Those who were acting there as the pioneers of the profession, and strenuously working against initial difficulties and prejudices would, he was sure, receive the sympathy and support of the members of the Institution, and also the aid which full discussion would give them in the shape of advice and information.

We are doing the most practical and valuable type of missionary work when we train water engineers and persuade our Chinese friends to initiate schemes of water storage and supply.

For the Community

I like the ideas expressed in the Preamble of the Constitution of the American Engineering Council in which the following words are used "As service to others is the expression of the highest motives to which men respond and as duty to contribute to the public demands the best efforts man can put forth, now therefore the engineering and allied technical societies . . . . . realize a long cherished ideal—a comprehensive organization dedicated to the service of the community, the state, and nation."

In actual fact all engineering societies produce work that must, of necessity, extend outside the narrow limits of nationalism. The search-light of publicity makes known everywhere the schemes and the works successfully carried out in any corner of the world. The technical press explains in detail the work already successfully accomplished. If Chinese public opinion is to be aroused in favor

of engineering schemes not only must we have a well trained army of Chinese engineers, but we must encourage the publicity of all engineering works accomplished and new proposals put forward.

It is fortunate that in Hongkong all of the engineering government work—architectural, construction of roads, water supply, drainage, etc.—is concentrated in the one Department of Public Works. But there is room for more co-operation by the technical men, outside of government employ, in Hongkong, as elsewhere, for the purpose of injecting into government those engineering principles of organization and operation which have been so effective in other lines of human activity.

Public Works in China

Every friend of the people should advocate imitation in each province of China of the Public Works now existing in Hongkong; every patriotic Chinese should realize how urgent are the problems involved in these matters. They have been solved in Hongkong. They cry for an immediate solution in China.

As with so many other problems, there has not been perfection in this matter in Hongkong. The bad mistakes have not been made by the technical men, but by those who were responsible for financing the schemes suggested. The story of delay, in spite of the desperate struggle of the engineers to persuade the local Government of the urgency of the matter,—that story is one that reveals no sound judgment and no great courage, on the part of those in executive authority.

It is, fortunately, a thing of the past but it left the lesson. Although it is unlikely to be repeated in Hongkong in connection with water supply, obstruction frequently confronts engineers all over the world and varies only in degree. For the inertia of the unscientifically trained mind retards the progress on behalf of which the engineer expends all his energies.

It is not claimed that government would be successfully operated by a council consisting only of engineering experts. No modern government can function successfully without guidance from experts with respect to fiscal, legal and legislative affairs, public works and welfare, commerce, trade and many other details. But engineers have reason to complain that, in the past at any rate, government has grown to large proportions almost without design or plan. We want the Government of China and Provincial Governments to carry out urgently needed engineering work, and to obtain the best expert advice for the design and general supervision of such schemes.

Water Engineers

The nature of the works required for the control of water have led to the development of this special branch of engineering. Young men are now trained to specialize in one of the many sections of applied science. The elementary training for all professional engineers is, roughly, the same all over the world. It is essential for the qualified engineer to have a knowledge of science, mathematics and the general principles of the behavior of materials under stress, the uses of electricity, the generation of power and workshop practice. The things all form the details of instruction for the University degree.

We advise our engineering graduates in Hongkong to travel abroad after they have obtained a degree. Anyone who wishes to specialize as a water engineer should take a post-graduate course in that subject in Europe or America and visit the more important works.

Rainfall Variations

It must be obvious that the problems to be solved by water engineers vary in different parts of the world. Asia in general, and China in particular, contains huge rivers, evidence either of excessive rainfall or of rapid melting of mountain snow.

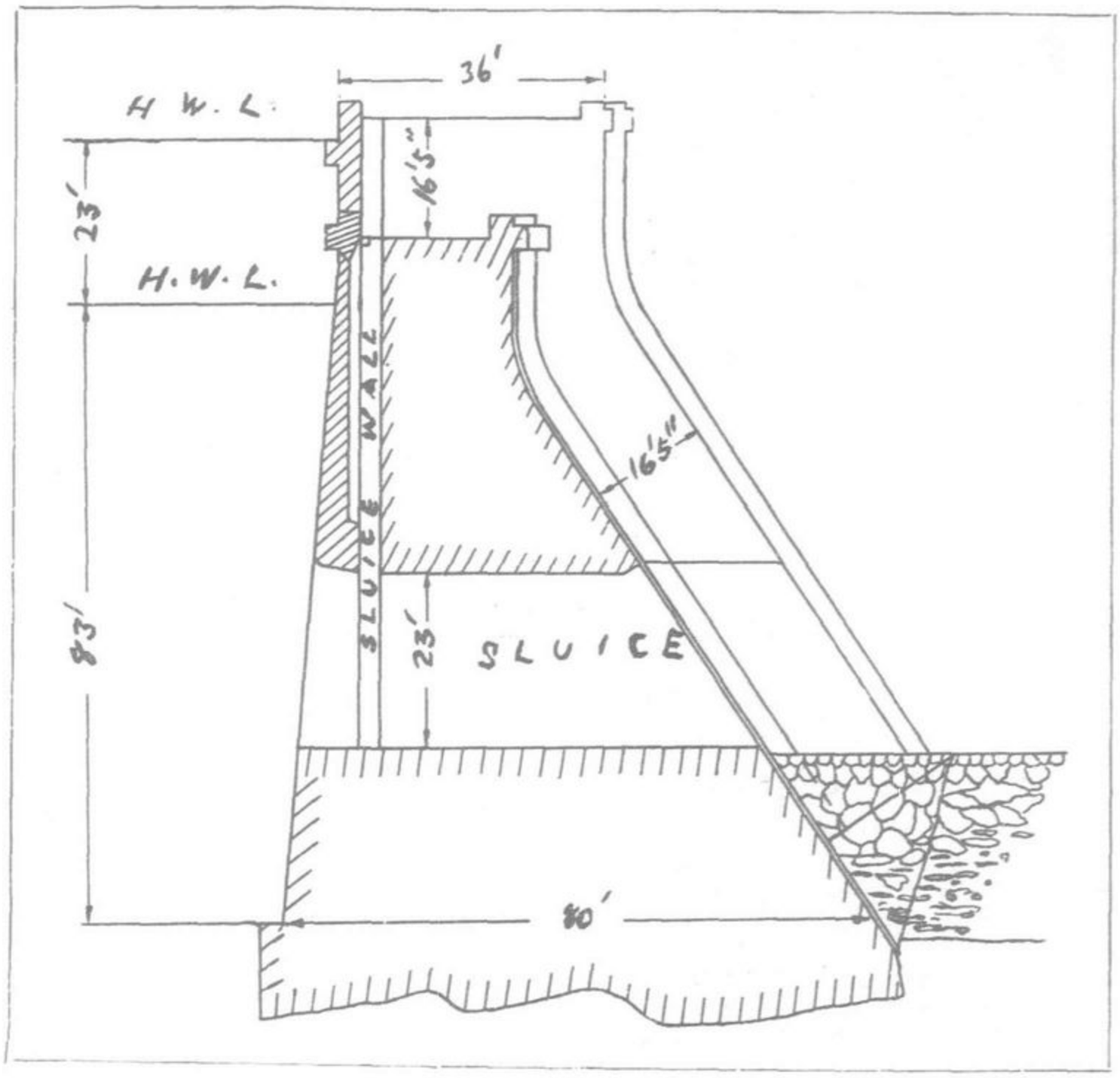


Fig. 2.—The Assuan Dam. This is about one-and-a-quarter mile long. Before it was raised and strengthened, as shown in this diagram its masonry weighed over a million tons. The capacity of the Reservoir as originally built was 37,611,000,000 cubic feet. By raising the height of the dam 16.5 feet and the high water level 23 feet the capacity of the reservoir was doubled and is now 80,000,000,000 cubic feet. The height of the dam is being raised a second time

The inequalities in the distribution of rainfall are not only those that relate to time, but also to place. The rainfall of one region may be abundant, of another the reverse. The rainfall of certain seasons of the year may be heavy, while that of other seasons may be light or wanting altogether. In some countries the inequalities of both kinds are not sufficiently pronounced for a distinction to be made between regions of abundant and of scant rainfall, and between rainy and dry seasons.

In India the variations of rainfall, both as to place and time, are extreme. In Sind and parts of the Punjab the average rainfall of the year is three inches only; in the Central Provinces the annual rainfall is, in places, from 50 to 60 inches; while in the mountains of the west coast and in the Himalayas it varies from 50 to 100 inches and is sometimes as high as 150 inches. The distribution in time is as unequal as the distribution in place. In the Madras Province 12 inches of rainfall, or about one quarter of the total annual amount, is sometimes recorded in twenty-four hours!

So also in the United States of America, the conditions of the country range from arid to humid in consequence of wide variations in the rainfall.

Egypt may be selected as an example of a country under extreme conditions of another sort: it has neither rainy region nor rainy season, and, as far as agriculture is concerned, may be reckoned rainless. But from the point of view of water supply it should not be taken alone. Its creation and continued existence is due entirely to the fact that it is a portion of the Nile country, which has its rainy regions in Abyssinia and the Sudan; and that it lies on the track of the run-off of the rainfall. It is this that makes irrigation in Egypt possible. So it is with all irrigation systems—the country irrigated must lie on the track of the run-off of the rain that falls in the catchment area to which it belongs. For rainfall is the primary source of all irrigation, even of that effected from wells.

In China, the enormous "run-off" of the Yangtze is due to the melting of the snows in mountaius far away from the sea.

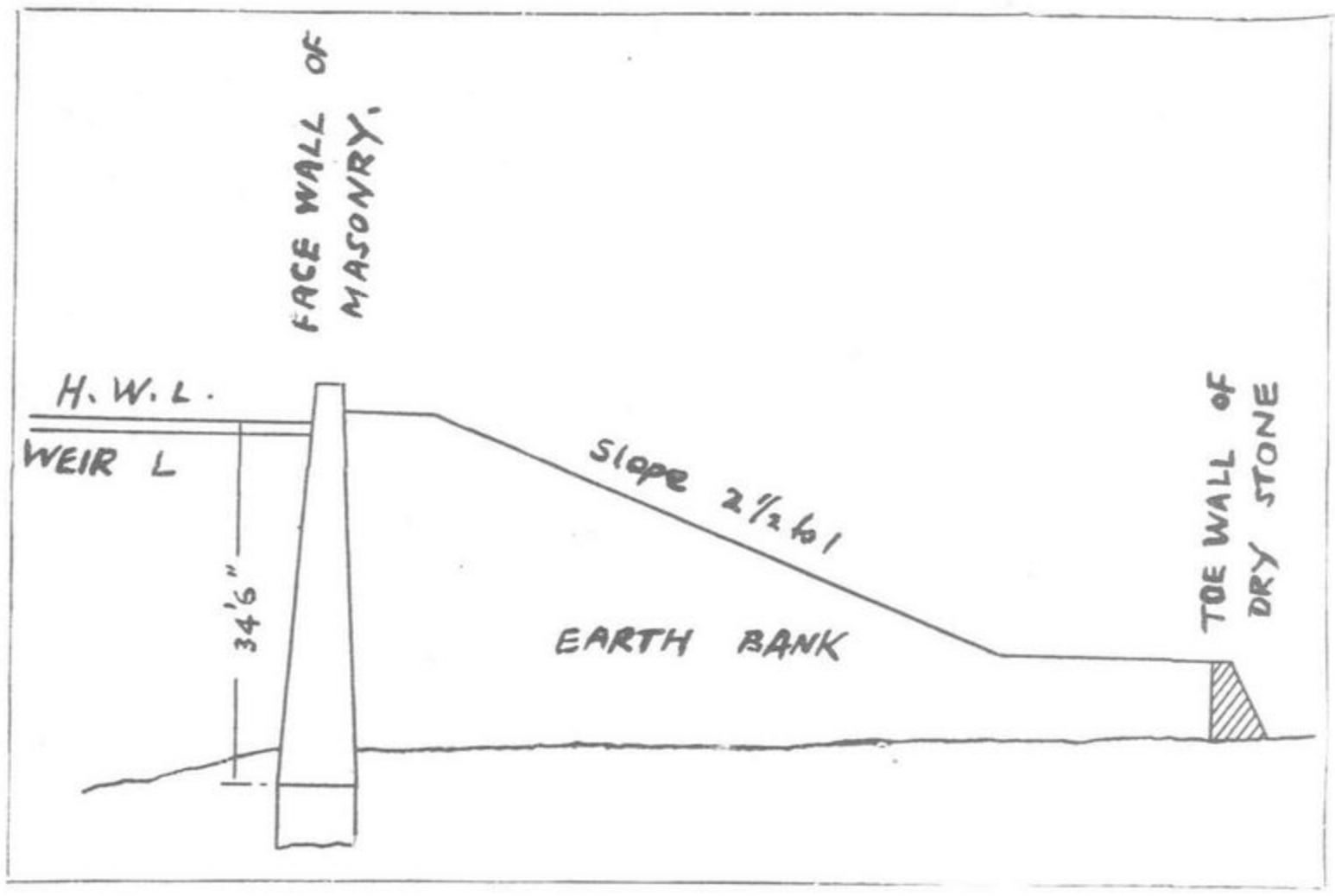


Fig. 3.—Foy Sugar Tank Dam. In this case the face wall of masony makes the dam watertight. The earth bank resists the water pressure

Some day this huge Yangtze basin will be the scene of magnificent works carried out by engineers. There are enormous possibilities of flood prevention, water power development, improvement of agriculture in that huge area. All that is required is scientific regulation of the vast volumes of water that flow through the valley of the Yangtze to the sea.

An Advanced Civilization

The water that is utilized for irrigation must naturally have fallen as rain somewhere in the catchment area above the point at which it is applied to the land surface. There are some countries which, though their rainfall is so small as to be an absolutely negligible factor in agriculture, have still been renowned for their prosperity, for wealth of crops, and for advanced civilization in days long past. The best known instances are those of Egypt and Mesopotamia, the lands of the Nile and the Euphrates. Both these rivers in their natural state annually flooded the lands bordering their lower reaches, so that the rain that had fallen in the region where their sources lie was spread over the surface of the country, and a natural system of irrigation by inundation resulted. In Egypt this natural inundation was assisted and controlled by artificial banks and means of regulation with such success that in the time of Joseph " all countries " came into Egypt to buy corn ; and, later on, the land of the Nile became the granary of Rome. The artifical system of irrigation which grew out of the natural peculiarities of the Nile is known as the basin system ; and is to be found, even to-day, on a vaster scale and in a more elaborately developed stage in Egypt than anywhere else in the world. It was under this system that Egypt attained to the heights of civilization which it reached under the Pharaohs of the old dynasties. Pharaoh did not tell the Nile what to do ; it was the Nile that told Pharaoh what to do.

In the ancient days the engineers of Chaldea—now called Mesopotamia—showed great skill in the control of water, and recently discovered and deciphered inscriptions prove their ability. One of Babylon's great monarchs, probably contemporary of Abraham, wrote. " I have made water flow in the dry channels and have given an unfailing supply to the people . . . . . I have changed desert plains into well-watered lands. I have given them fertility and plenty, and made them an abode of happiness."

The Desert Formed

But where was once animation and prosperity, the region became a desert because of neglect of the water system. Under recent schemes much of the desert will be reclaimed. The rivers Euphrates and Tigris can be utilized to bring back prosperity.

Mesopotamia furnishes an example of a country which flourished exceedingly by reason of its irrigation works, and fell to utter ruin when these works were overwhelmed. Some day, in the fullness of time, the successors of the Chaldean engineers will lay firm hands upon the twin rivers, and compel them to flow for the service of the lands through which they pass, that the good that has been may come again when the time of regeneration shall return.

Egypt has benefitted enormously from the huge reservoirs built in recent years to regulate the supply of water. The value of land has been more than doubled.

The historical record of water supply in India does not go so far back as that of Mesopotamia or Egypt. It was about 300 B.C. that Megasthenes, writing of India, referred to the advantage of double crops resulting from irrigation, whereas the cuneiform inscription of Hammurabi, furnishes evidence of the practice of irrigation in Babylonia as far back as 2,200 B.C. ; and the hieroglyphic records of the Pharaohs of the twelfth dynasty, of date about 2,500 B.C. do the same for Egypt.

Very early records show that the Chinese appreciated the value of irrigation in the dawn of their civilization. In Szechuen, it is believed, the first efforts to train water over agricultural lands were made. The remarkable canal system, including the Grand Canal, shows that they had fine water engineers centuries ago. All over South China, to-day, there is extensive irrigation to increase the rice crops.

The Wilderness and Desert Reclaimed

But it is modern results which are of present interest from a practical point of view. As one of the most recent constructions, the Chenab Canal in India is a noteworthy example. Mr. R. B. Buckley, in " The Irrigation Works of India," thus describes the effect of its construction :—

" The tract which it commands, known as the Rechna Doab, is nearly all Crown land. Before the construction of the canal it was entirely waste, with an extremely small population, which was mostly nomad. Some portion of the country was wooded with jungle trees, some was covered with small scrub camel thorn, and large tracts were absolutely bare, producing only, on occasions, a brilliant mirage of unbounded sheets of fictitious water. Such was the country into which 400 miles of main canals and 1,200 miles of distributaries now distribute the waters of the Chenab, turning some 2,000,000 acres of wilderness into sheets of luxuriant crops . . . . . About 1,500,000 acres of the Crown lands have now been allotted to colonists, and a new population of a million people have founded home-steads which they cultivate with the waters of the Chenab Canal."

Considering India as a whole, the result of the work done by the engineers of the British Government during the past half-century is an increase of the area watered by Government irrigation works from 3,000,000 or 4,000,000 to 21,500,000 acres, brought about by a capital expenditure of about £30,000,000, on which the net profit amounts to seven per cent. This takes no account of the indirect profits. The value of the crops raised is estimated at £26,000,000, or 87 per cent of the capital expenditure on the canals by which they are irrigated.

America's Great Scheme

The result of irrigation in the United States is thus described by Mr. Elwood Mead in his paper read at the International Engineering Congress of 1904 : " Since 1900 the arid region has enjoyed great prosperity. There has been an increase in western settlement, and the values of both land and water have had rapid and continued advance. Land in the Yakima valley, Washington, which could have been purchased five years ago for $15 an acre, now sells for $75 an acre. Land in the Turlock and Modesto districts, in California, which sold for $20 an acre three years ago, now brings $60 an acre. Water rights in Idaho, which in 1894 found no buyers at $10 an acre, now have prompt sale at $25 an acre."

Some Enormous Structures

In the previous contributions of this series reference was made to the methods of construction of the dams built in Hongkong. Of these the Shing Mun dam is the most interesting from a technical point of view as, when finished, it will rank as the highest dam in any part of the world except the U.S.A.

In that country astonishing feats of dam construction have been accomplished, and the eight highest dams in the world are to be found in various States. The formation of the country, especially the range of giant mountains known as the Rockies, cause huge quantities of water to flow to the sea. And in that respect China resembles the U.S.A. It requires no very vivid imagination to realize that it is practically certain that, as China develops her natural resources, huge dams will be built.

It must be remembered that although the volume of a dam increases rapidly as the height increases, yet the length of the dam, as well as the height, is an important factor in the cost and the volume, there are dams that are nothing like as high as the Shing Mun dam but they are ever so much longer and more costly.

It is of interest to tabulate the heights of fifteen of the world's highest dams : of these the Boulder Canyon dam in Colorado may be considered one of the wonders of the world. But engineers may build bigger dams in Asia if they are able to persuade Governments to finance the huge expenditure involved.

The World's Greatest Dams

Boulder Canyon	727 feet high
San Gabriel, California	435 ,,
Owyhee R., Oregon	405 ,,
Skagit R., Seattle	400 ,,
Pacoima, Los Angeles	365 ,,
Pardee, California	357 ,,
Arrow Rock, U.S.A.	349 ,,
Tuolumne R., U.S.A.	341 ,,
Shing Mun	300 ,,
Burrunjuck, Australia	240 ,,
Avon, Australia	230 ,,
Indus, India	190 ,,
Cordeaux, Australia	182 ,,
Assuan, Egypt	144 ,,
Gunong Pulai, Johore	120 ,,

The greatest engineering feat yet attempted by man is that which will utilize the rushing waters of the Colorado river, U.S.A. For countless centuries millions of gallons of water, each day, have carved a way through the tremendous gorges which they created and the result has been ravaging floods and dry seasons when crops have withered in the sun. That tragedy will soon be rectified.

Below the huge Boulder Dam the once untamed Colorado river will become regulated and standardized. Far away cities in Southern California will benefit by a constant supply of pure water, and electric power will be fed into Arizona, Nevada and Southern California as a result of this water conservation.

It is estimated that it will require four or five years to fill up the huge reservoir that will be formed behind the giant Boulder Dam, but long before then water will be racing through the turbines to supply, not only water to irrigate lands, but electricity to put power behind the worker.

It is a most courageous and amazing project. It will turn the desert into a paradise and enormously increase both the population and the amenities of life in the enormous area that must benefit from the scheme.

The Benefit to States and Cities

America is a land of the superlative in engineering works and easily heads the list of countries possessing high dams. And the greatest superlative of all is the famous Boulder Dam in Colorado.

Authorized in 1928, it is mainly the result of Herbert Hoover's activities when he was Secretary of Commerce. It fits beautifully into Roosevelt's pattern of the New Deal.

For more than 54 months work on the great dam in the Canyon of Colorado has been going on. It is believed that in May, 1935, the last bucket of concrete will be thrown on the top of the dam, 720 feet above the Canyon bed. There will be seven million tons of concrete in the Boulder dam—the greatest pile of cement, sand and stone in existence.

It is believed that it will take four years to fill up the reservoir which in places will be 1,000 feet deep. It is the greatest single industrial project ever worked out in the United States. The Colorado river will for the first time in its history, be regulated.

But civilization, as created by the engineer, has come to that region as it is gradually spreading all over the world. Far away cities will draw upon the impounded waters ; 1,800,000 horse-power of electrical energy will be transmitted from the turbines utilizing the fall of the water as it goes on to its final mission of providing a constant supply.

Cooling the Concrete

Perhaps the most remarkable feature of this huge structure, the Boulder Dam, is the use of a refrigeration plant and 750 miles of piping to cool the enormous mass of concrete as the buckets empty the material on to the dam.

It is an extraordinary innovation in dam construction. The chemical reactions of the cement and water in the more or less fluid mass of concrete, just after it is mixed, produces temperatures of about 130 degrees. These temperatures can only be reduced by radiation. But the enormous mass of the concrete in the Boulder dam—7,000,000 tons of concrete—makes it essential to place huge quantities of newly mixed concrete in position daily. From that huge mass air radiation would take about two centuries for the concrete to cool. And with slow cooling would come contraction—with cracks, shrinkages, meaning weakness in the dam, and danger of collapse.

And so this astounding system of artificial cooling has been installed. If cracks develop as the concrete is being rapidly reduced from 130 degrees to about 40 degrees, they are filled in with cement. And when the work of the refrigerating pipes is finished, cement will fill the 750 miles of piping buried for ever within the dam. And so this huge mass will not only be water-tight but proof against any danger due to slow cooling of the millions of tons of concrete.

And when finished there will be 4,400,000 cubic yards of concrete in that greatest of all engineering wonders of the world. It has been calculated that the enormous quantity of concrete in the dam is sufficient to build a 16-ft. highway from Florida to Seattle.

From the engineers' point of view the most interesting feature of all of these schemes for impounding water in reservoirs is the design of the dams used to withstand the very great pressure of the water behind them.

It is obvious, of course, that the water pressure increases considerably on sections that have to hold up greater depths of water. That is why dams are so very much thicker at the base than higher up.

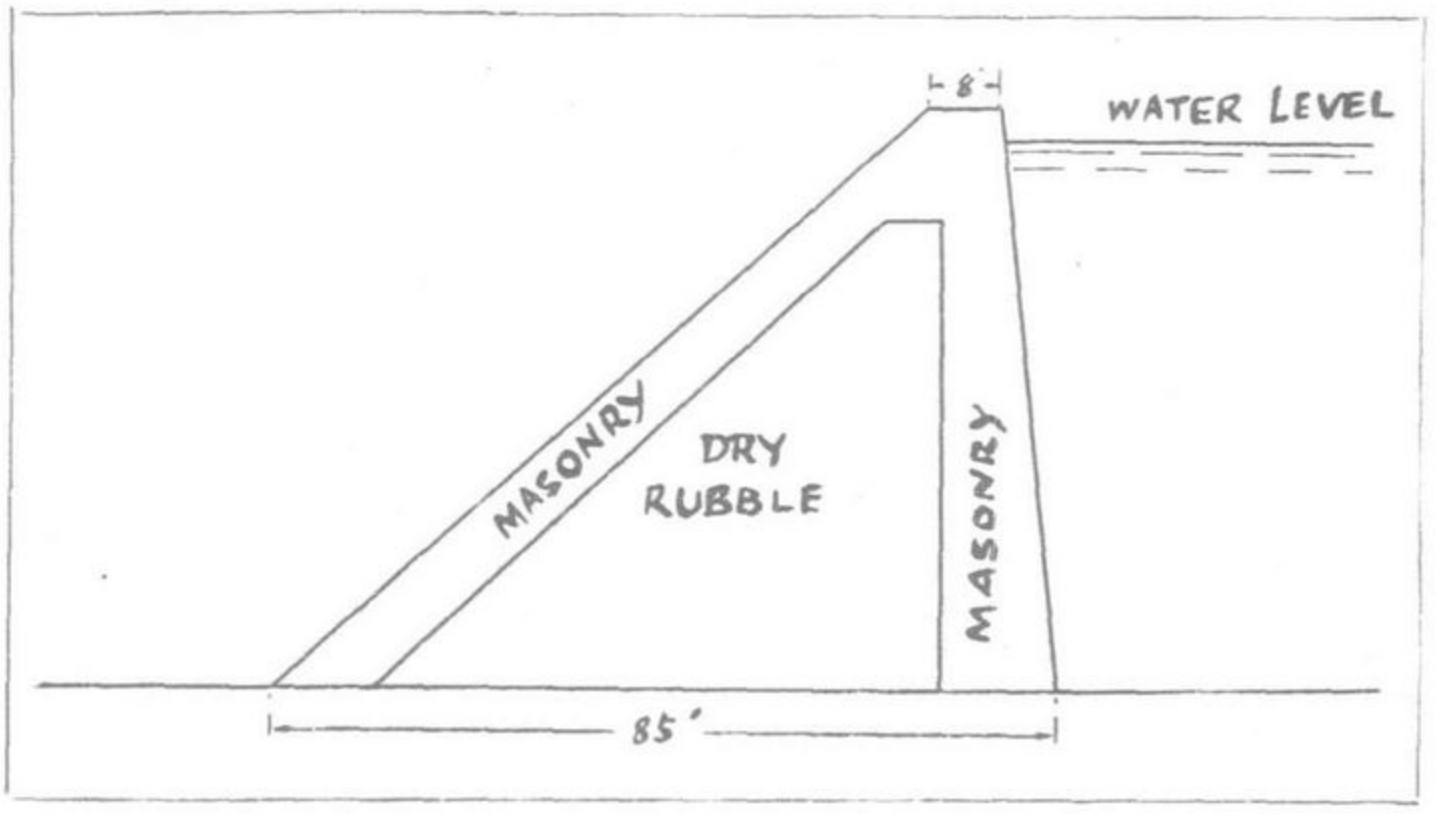


Fig. 4.—Castlewood Reservoir Dam, Colorado. This type of dam is not popular. The "Walnut Grove" Dam, 110 feet high, which collapsed in 1890 was of this type

Concerning Dams

Let us now consider some of the examples of dam construction that nowadays can be found all over the world.

There have been dreadful disasters caused

by the failures of dams. But when it is remembered that many thousands have been built, it is remarkable how few have been the failures.

The ingenuity of engineers has been employed on calculations, researches and devices to ensure safety. The results of the collapse of a dam are so awful that a large factor of safety is taken in all calculations.

During the last fifty years a very large number of dams have been built in different parts of the world. They have formed reservoirs for (1) water supply to cities (2) irrigation purposes (3) hydro-electric power schemes.

Long before the Christian era dams were built to store up water for irrigation work. There are traces in Egypt and other places showing that as soon as civilization dawned, the human race realized the necessity to store water. Especially was that the case in countries with long dry seasons.

For many centuries dams were built by more or less rule of thumb methods. The problem seemed to be fairly simple. It was to provide a sufficient weight of material to withstand the overturning force due to water pressure on the face of the dam. And also, of course, to prevent water leaking under, round, or through the dam.

As engineering science developed, and mathematical analysis, experimental methods, and recorded observations concerning these massive structures were taken into consideration, other factors were seen to be important. The provision of new materials—especially Portland cement—made a very great difference to the constructions of dams.

And so there have been evolved all sorts of designs and methods of building dams.

For some years the Assuan dam in Egypt (originally 144 feet high, but since to be raised in height by two big additions to the dam, one of which is in course of construction now) was the most remarkable structure. It was a fine feat of engineering, but it was notable also because of the novel method of financing the work and because it enormously increased the production of saleable material (rice and cotton) in Egypt and so increased the wealth of the country. Similarly with other dams in Egypt, where unproductive land was made fertile by building large reservoirs to supply water for irrigation.

The Metur Dam

In India the work done by British engineers transformed vast areas of land in a similar fashion. The latest triumph is the great scheme of irrigation in the Madras Presidency. The building of the great dam at Metur, a structure 176 feet in height and 5,300 feet in length, permits irrigation of a little over a million acres of land, the irrigation season being from June to February. Rice is the predominating crop. The frequency and magnitude of floods in the rainy season is also reduced. The volume of masonry in this dam is estimated at 38½ million cubic feet.

The famous Tata hydro-electric scheme in India, similar schemes of varying sizes in hundreds of other places in all parts of the world where electricity is generated by water power, have caused dams to be built to impound the necessary water. And many more schemes have been projected and will be carried out in the next few years.

In Russia they have recently built enormous dams in connection with their industrialization plans. Even little Ireland has harnessed the waters of its Shannon river.

The Yung River Dam

It would be possible to fill many pages of this journal with descriptions of the work of the builders of dams all over the world.

And what of China? A beginning has been made on the Yung river in Kwangtung with a dam to hold up water for a hydro-electric scheme to provide 40,000 kilowatts.

That is but a beginning. China is a land that has suffered, more than any, from ravages of flood, from terrible famines, both of which evils can be obliterated by the regulation of the rivers. And there are great possibilities of putting power behind the worker by means of hydro-electric schemes.

Recently the Mayor of Canton, and several other Chinese officials, visited the site at Shing Mun. It is to be hoped that every Chinese Official, interested in the development of the natural resources of his country, will see what is being done here.

The Type of Dam

It will be impossible to discuss in detail the enormous number of designs and methods of building dams. Each one is a problem of itself. It will, however, be of interest to explain some general principles that assist the engineer to overcome the difficulties presented to him.

The subject of dam construction is of the utmost importance in China where there are numerous projects awaiting the work of the engineer for holding up water not only in connection with water supply for towns but for irrigation and flood prevention purposes. As engineering works have increased in size so have the difficulties in design and construction become greater. That has led to intense specialization which has caused the design and construction of large masonry dams to be a matter which must lie in the hands of experts on the subject.

There are many factors which influence both the choice of the general type of dam to be designed, the details of the design, and the methods employed in building the dam. Amongst other considerations are the following, viz. the character of the site, the natural foundations, the quality of available materials and workmanship, local climate, consequences of partial or total failure, and the funds available.

Nature Decides

Of course the first requisite for a dam is strength; next, the materials must be arranged to furnish this strength with the minimum of cost.

The margin of safety allowed, and the permissible cost, for a dam will vary widely from a principal dam in a great metropolitan water supply scheme, situated upstream from a populous and expensive territory, to an unimportant dam in the wilderness. The worst possible conditions must be borne in mind, and they may not occur for many years. Because a dam has held up for a number of years that does not prove it is permanently secure.

As a rule the general configuration of the ground determines the best site for a reservoir. The selection of the site is not so much a matter of choice by the engineer as a recognition of Nature's decision in the matter.

The dam, which is the principal feature of a reservoir project, may be made of earth or of masonry, or of a combination of both. There are dams of a type peculiar to Americans known as "rock-fill" and "loose rock" dams. They are formed of a mass of rubble with a watertight facing, which may be of planks, of asphalt or Portland cement concrete, of masonry, of steel plates, or of earth. Another type peculiar to America is a dam, either of earth or loose stone, with a central core of steel plates forming a watertight diaphragm embedded in the mass of the dam.

Masonry dams may be classified as—

(*a*) Solid submergible dams, over the crest of which the discharge passes;

(*b*) Solid insubmergible dams, with waste weirs to discharge excess water, and outlets for the delivery of the stored water;

(*c*) Insubmergible dams, pierced with numerous sluices, through which the discharge is passed.

Earthen dams must always be insubmergible, and be provided with waste weirs and outlets. They may be divided into three classes, namely—(*d*) Dams with a masonry core wall; (*e*) Dams with a central puddle core; (*f*) Dams entirely of earth without core walls.

The question as to which class of dam is the most suitable for any particular site depends to a great extent on the nature of the foundation. A high masonry dam must have sound rock for its foundation. This is a *sine qua non*. An earthen dam may be built on sandy or gravelly clay, fine sand or loam, and also on rock if proper precautions are taken to prevent creep of water between the bed of the dam and the rock surface. Earthen dams can be safely built up to 150 feet in height, though French engineers fix the safety limit at a lower point. No doubt 90 feet is a safer limit than any greater height, but there are earthen dams exceeding 150 feet in height, which have now been tested by many years of useful work.

To Prevent Leakage

The choice between earth and masonry for dam construction is affected also by economical considerations and the facilities for transporting materials to the site of the work.

At Shing Mun the new dam will have most ingenious details of design. A great problem has been to ensure that it is watertight as well as economical in construction.

It is difficult to ensure watertightness unless solid masonry is used throughout. In the case of earthen dams as stated above a central core of solid material is used, but it is not so reliable as solid masonry throughout the dam. (Fig 1).

If the material of the dam is not absolutely watertight, water will find its way through the mass of the dam to the downstream face, possibly to a dangerous extent. To provide against this, the puddle trench has been sometimes developed into the puddle core, by carrying up the puddle as a thin wall, in continuation of the puddle in the foundation trench from the bottom of the dam to above high water level. By this means the penetration of water into the mass of the dam is confined to the half of it upstream of the puddle wall, and the stability of the downstream half is not affected by any soakage. Regarding the dimensions to be given to puddle walls opinions differ, the Rankine's rule is that the thickness at the base should be about one-third of the height, and the thickness at the top two-thirds or one-half that of the base.

The objection to a puddle core is that it is liable to rupture from unequal settlement of the earthwork of the dam, and it then ceases to be watertight. For this reason, masonry core walls are to be preferred, though, generally speaking, their cost would be considerably greater. Other types of dam are shown in Figs 1 and 2. In general, nowadays, dams use masonry, wholly or partially, resist water pressure.

Forces Acting on Dams

The design of all dams depend on certain fundamental principles.

The forces acting on a dam are (1) the pressure of the water in the reservoir exerted in a direction at right angles to the upstream face and (2) the weight of the dam itself acting vertically.

In a masonry gravity dam the conditions of stability, as commonly accepted, are three, namely :—

(1) The lines of pressure, both when the reservoir is full, and when it is empty, must lie within the center third of the cross-section ;

(2) The pressures in the masonry or on the foundations must never exceed safe limits ;

(3) The friction between the dam and its foundation bed, or between any two parts into which the dam may be divided, must be sufficient to prevent sliding. Big dams are of comparatively recent date.

The Alicante dam, of 140 feet greatest height, was built between the years 1579 and 1594 : but the Almanza dam, 68 feet high, was built at some unknown date long before. Nearly all the dams of Spain are built across mountain gorges on rock foundations.

The Almanza dam was the first dam which recognized the principal of varying water load from top to bottom and the first that was built to a triangular section. Up to that time dams had been rectangular in section, i.e., same width at top and at bottom.

The construction of the Furens dam in France, between the years 1862 and 1866, marks the next great advance in dam building. The French engineers were the first to work out the scientific principles according to which dams should be designed, and to test their soundness by applying them to actual practice. The Furens dam, of a greatest height of 177 feet from foundation to crest, was the first dam to which these principles were applied.

In the previous contributions of this series sections of dams built in Hongkong have been shown. Enough has been explained to convince the reader that dam design and construction is a very difficult and complicated problem demanding the knowledge and experience of experts.

This concludes the story of reservoirs and water supply. It is a most fascinating branch of engineering and it is to be hoped that many young Chinese engineers will study it in detail.

Engineers are generally supposed to be without sentiment, but that is not strictly true. It is doubtful whether any section of the population in those countries which have the benefit of modern science are more intent upon improving the standard of living in all parts of the world than are engineers ; it is noticeable that the Anglo-Saxon engineer abroad is devoted to the land of his birth, which he always refers to as "home" ; and, for all his practical training, he has definite ideals up to which he seeks to live. The lives of Faraday, Ferranti, Steinmetz, and many others famous in the annals of engineering history, prove that there have been any number in the profession whose work has been inspired by the most lofty ideals of service to humanity.

The Problem of the Engineer in China

For twenty-one years the writer has lived in this little outport of the British Empire off the farflung coast of China. He has travelled many thousands of miles in China and has met thousands of educated Chinese. And he has seen many changes in the Far East during those long years.

Almost every building on the island of Hongkong is erected either on land cut out of the steep hillside, or on ground reclaimed from the sea. Yet, after only ninety years of development, there are now wide roads made level by being cut out of the hillside : three large modern dockyards have been made and vessels of 10,000 tons have been built and equipped in Hongkong ; there are several smaller shipbuilding and repairing yards and engineering works ; there are industrial establishments of all sorts ; an efficient Public Works Department with a large staff of engineers ; Government Hospitals and Schools ; a University ; there are efficient electrical generating stations, and many other amenities that make life safe and pleasant in this subtropical part of geographical China.

Above all else Hongkong has been, and is, an object lesson for the rest of China concerning the advantages of Applied Science. It is not too much to say that Hongkong is a triumph of the engineer. For many years this object lesson seemed to have no effect on China ; but during the last two decades—and especially in the last ten years—the Chinese have realized that it is very much to their individual and national advantage to make use of the knowledge and experience gained by the engineer. Especially do they realize nowadays that such knowledge pays in industry. They are beginning to see that the fundamental basis of modern industrial methods is efficient electric power production.

The Standard of Living

British merchants, and, indeed, all of the many representatives of the various sections of the community in China, with whom the writer has discussed the subject, heartily approved of Mr. T. V. Soong's statement concerning China's still untapped resources. "It is the settled aim of my Government to develop China's consuming power," he told the delegates at the World Economic Conference ; and then he made the important statement, "we mean so to organize the country that we can raise the standard of living."

For years the writer has been placing before readers, in slightly different words, the statement made by "T. V." that "if the standard of living in China were raised, the consuming power would not only absorb China's own industrial production, but would provide the greatest of all markets for the world—so great as to be a decisive factor in a new era of prosperity."

As a matter of fact the standard of living of the Chinese in Shanghai and other ports of China has increased greatly in recent years. But in the interior it is still very low.

It must be remembered that, even to-day, China is almost entirely dependent on agricultural produce for its wealth—a few mines have been developed, but only the surface of the mineral wealth of China has been scratched. In Shanghai, Tientsin and Hankow there are modern factories, but at present they supply only a fraction of the manufactured goods that China consumes.

It is most noticeable that thoughtful Chinese now realize that they must have the co-operation of foreigners for the development of the natural resources of China.

The Foreign Importer

The manufacturer in Britain or America is naturally anxious to know something of the type of machinery that is in demand in China.

There is, and will remain for many years to come, a wide market for imported plant and machinery of all descriptions. But the tendency will be for the Chinese themselves (often in co-operation with Europeans established within the Chinese tariff walls) to manufacture lighter articles. Every year the foreign imports will consist more and more of heavy machinery.

To-day, in Shanghai, Canton, Tientsin and other centers of China mass production of certain articles is in full swing. Textile mills employ many thousands of workers and the demand for piece-goods from Lancashire has been replaced by demands for the engineering equipment for cotton mills in China.

It is significant that only a few days ago there was a ceremony in Canton, in which Chinese Government officials and the British Consul-General played a leading part, marking a new development in that ancient city. It was laying the foundation stone for a new cotton mill to be equipped throughout with British machinery. If, as is expected, it succeeds other orders must follow. It has its own power plant and all of the electrical equipment was made in Britain.

Modern Machines in China

In Shanghai, mass production of matches is now carried out by the latest machinery used in that class of work. In Canton, the recently equipped cement works use the most up-to-date machinery. Large quantities of cement are manufactured and extensions of plant are in hand.

They are making electric lamps, small electric motors and switches in China, but the demand for the bigger equipment, especially that required in large scale plants, must continue for many years to come, and it must be imported from Europe or America.

In that connection a word may be said about the absolute necessity of training Chinese engineers capable of installing, maintaining and initiating new schemes. That work can only be done by Chinese trained to the usual high standard of a recognized University and with some experience of practical work, preferably gained abroad. That is our endeavor in the University of Hongkong. And we have examples of graduates who have done valuable pioneer engineering work in China.

The Chinese Workmen

Great as are the, as yet, undeveloped natural resources in China, perhaps the most valuable asset of the nation is the industrious, intelligent and (usually) cheerful Chinese workmen.

After twenty-one years of close contact with Chinese artisans, the writer has no hesitation in saying that they really are good workmen. And what has been impressed so deeply on my mind, more than anything else, is their invariable good-temper. If you treat them fairly, you will obtain faithful and loyal service.

Unfortunately, even amongst so-called educated Europeans, you come across the type who is so ignorant that in China he does an immense amount of harm. Some Europeans are so stupid that they lack a most elementary knowledge of psychology and history. The Chinese have a national culture, a civilization that if static, is based upon an amazing literature that includes a highly developed moral code. They have a social science that has bound together the nation over a period outlasting that of any other people. It is absurd to suppose that all Chinese are uncultured.

The Chinese intellectuals of the new generation are anxious to speed up the development of engineering science in their own country. Dr. Hu Shih is an ardent advocate and his words carry great weight all over the world.

We may, therefore, be sure that the next few years will see great advances in China. It is hoped that these articles concerning the control and supply of water will be some service in helping forward in China schemes outlined in these contributions.

Coming of the Power Era

(Continued from page 538)

There can be no doubt that it is a very great advantage for a Chinese engineering graduate to see modern industrial conditions abroad. And the ideal system of training undoubtedly is to obtain instruction to the standard of a University degree of recognized status in the Far East and subsequently to obtain experience under modern commercial conditions abroad.

The Returned Students

It is usual, if there is a discussion concerning Chinese engineering graduates with probable employers, to hear criticism concerning their lack of practical experience. It cannot be denied that there are, in China, a large number of students, returned from abroad, who are unable to find employment in the profession for which they have been trained.

That fact should not deter others from striving to obtain a University training, if they have a real desire for an engineering career. Even, if at the end of their training, they find that they have no natural bent for technical work, the scientific training has at least taught them the imperative need of accuracy.

We need not be discouraged because there are amongst those who have been trained, some who fail to succeed as engineers. In many cases they were entirely unsuited, by temperament, for the work. In many other cases family obligations have compelled them to carry on the work of relatives deceased.

We find, in Hongkong, that at the end of the first year's residence in the University, certain students fail to qualify in the examinations. They are permitted to take the first year's course again. But in the majority of cases they give up. Many seek out some institution abroad, where the course of instruction is less arduous. They return, in due course, to China with a qualification that is below the standard demanded by the leading Universities of the world. But unfortunately some employers fail to realize that fact.

Nor must it be forgotten that in Britain and in America a fairly large percentage of those who obtain engineering degrees subsequently drift into other work. There are numbers of examples of the same sort of thing in the other professions. Earl Reading (better known as Sir Rufus Isaacs) did not commence to earn a living as a barrister. Sir Arthur Conan Doyle was trained as a doctor but found fame as an author. One of our most brilliant Hongkong engineering graduates has done more to accelerate engineering work in China as a prominent politican than would have been possible for him to do if he had continued to practice as an engineer.

On the other hand there is ample evidence of the good work in China that has been done by Chinese engineers even in the post-war days many cities have been transformed, thousands of miles of new roads been built, a large number of fine modern buildings have been erected, valuable work in flood prevention and river conservancy has been accomplished.

There is, therefore, every hope that with increased facilities for the study of applied science, there will be a rapid development of the natural sources of energy in China and that must result in an improvement in the standard of living, unless the resulting wealth is frittered away by the rulers of the people.

Dredging Canton Rivers

The Municipal Government of Canton is taking steps to dredge the Canton River and the various waterways in the city. With the completion of the reclamation along the Canton Bund and the new bund along Honan Island the width of the Canton River has become much narrower. Therefore, it is considered by the Municipal authorities that the deepening of the river beds is of utmost importance so as to facilitate river traffic.

In addition to facilitating the navigation of boats and steamers the dredging of the Canton River would prevent the danger of flood from the West River during the autumn season. It is stated that this project would require a large sum in view of the wide area of the river.

The Municipal Government has already sent an official communication to the Bureau of Public Works asking the authorities to make a thorough investigation of navigation routes and to furnish an estimate for this engineering project. It is learned that the work for the deepening of the river beds will commence as soon as the plan and the estimates submitted by the Bureau of Public Works are approved.

Air Transportation in Japan and Manchuokuo*

ALTHOUGH Manchuokuo is not as yet recognized by Foreign Powers (except El Salvador), all foreign countries are closely watching its consolidation under Japanese military occupation, and many are hoping to get a share in the trading which its 30,000,000 population may be expected to do under more settled government. The old foreign treaties for freedom of trade have been recognized by the new Government, which, however, is already arranging to monopolize trade in certain lines, such as oil and tobacco. Hsinking, the new capital, is now an active commercial city with fine buildings, good Japanese hotels, motor-cars, accelerated and regularized train services and air services. The most modern methods and appliances have been introduced since 1932. The country is rich. It has fertile lands and forests, and it has minerals, including coal and gold not yet appraised.

In the first 18 months of their existence the new air services were used mainly by the Japanese Army, but their general employment for mails and for travelling by Government officials and merchants is the natural sequence. Japan soon realized that air transport must play an important part in the control of the country, the development of which means so much to the strength of her barrier against Russia—and, indeed, to the future of the Far East generally. A contented population, least likely to be attracted by Communist propaganda, is what Japan wishes to see in Manchuokuo ; and therein, apart from the trading ambitions of the occupying Power, lie the grounds for hope of commercial and general development.

The Federation of British Industries, which has watched progress closely for two years, has just decided to send out an Industrial Mission to see "whether British industry can co-operate with local interests." The F.B.I. is not blind, of course, to the fact that Japan means to supply the lion's share of Manchuokuo's needs in the way of manufactured goods. This applies even to aeroplanes and motors. Japan is doing her utmost to produce the aircraft which she and her protégé need for military and commercial purposes.

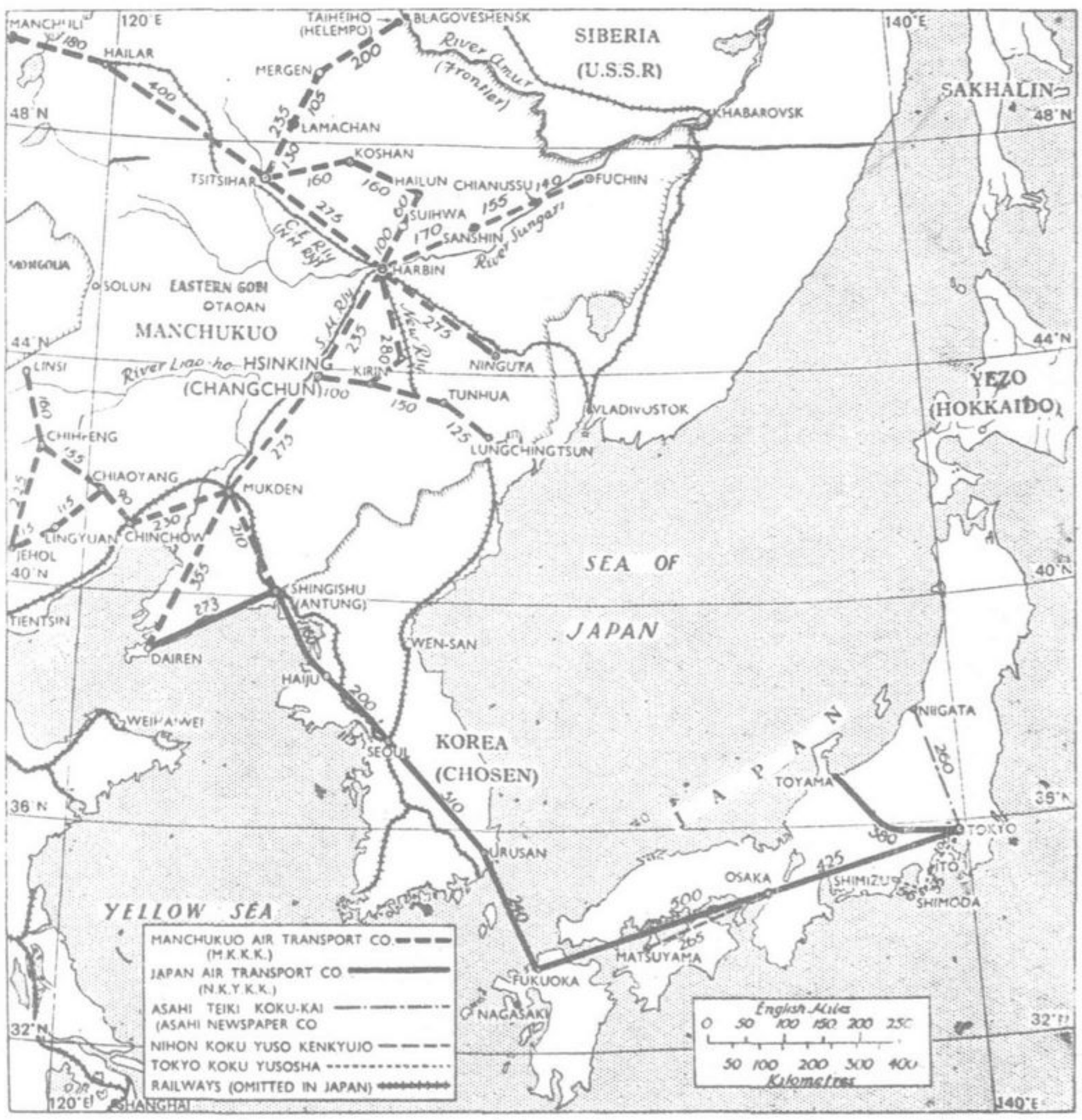
Communications were the first objective of the Japanese when they started to organize this interesting country. A direct railway connection from the east coast to Korea through Tunhua to the heart of Manchuokuo was quickly established. Other railway works are proceeding vigorously. Air lines were promptly organized—with machines drawn from the fleet of the Japanese Air Transport Co. Both railway and air routes have strong strategic importance, and Vladivostok and Hsinking are within comfortable bombing range of each other.

The Manchu Koku Kabushiki Kaisha (or Manchuokuo Air Navigation Co.) was registered on September 26, 1932, financed jointly by the Manchuokuo Government, the South Manchuria Railway Co. and the Sumitomo Goshi Kaisha. Its paid-up capital is Y.3,850,000 (£385,000 at exchange 2s. per yen). The head office is in Mukden. Air-mail and passenger services started on November 3, 1932, and have since operated with regularity and expansion.

The first route was between Shingishu and Mukden, an extension of the main Japanese line. This is operated daily each way except Sundays. The terminus of the Japanese line is at Dairen, so a connection between Dairen and Mukden was soon started. The main air route extends north from Hsinking to Harbin and Tsitsihar, and there are seven return trips weekly. An extension 580 km. to the west covers the vast expanse of northern Manchuria, west of the Hsingan Mountains, and, according to latest reports, is operated by two round trips a week.

Let us not forget that Manchuli is only 800 km. (500 miles) from Irkutsk, the Eastern terminus of the Russian air line. Four hours' flying (and a co-ordination between Russia and Japan which is hardly thinkable at the moment) constitute the missing link in the airway between Japan and all the European centers, including London.

Then there are the branch lines embracing the other principal areas of Manchuokuo. Perhaps the most important is the route from Hsinking to Lungchingtsun, 375 km. This affords the quickest access to the capital from the gateway in the Sea of Japan. At present there are three return flights weekly, and the associated Japanese company plans another air route to north-east Korea which will eventually link up (like the new railway does) at Lungchingtsun. All this is quite clear from the accompanying map.



Principal air routes of the Manchuokuo and Japanese national air-transport companies and of three smaller Japanese Concerns. Figures denote distances between towns in kilometers. For the sake of clearness, the network of railways in Japan, including Hokkaido, has been omitted. The more important strategic railways on the mainland are shown.

The latest reports say that the Korean Government is appropriating a sum to subsidize the new air line. The north-eastern route from Harbin to Fuchin (465 km.) has two or three return trips weekly, and the flight of under three hours compares with a three-day journey by Sungari steamboat. Until recently ordinary passengers had to get a permit to use this service, which was reserved for military and Government purposes.

On the opposite side of the River Amur to the Russian town of Blagoveshensk is Taiheiho, 435 km. from Tsitsihar. The air route to this northern

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* *The Aeroplane*

outpost was opened in July, 1933, and is flown thrice weekly each way. From Harbin, 275 km. in the direction of Vladivostok, is Ninguta, to which also an air service now operates. Between this line and the Tunhua branch there is a circuitous air route from Hsinking to Harbin, and between Harbin and Tsitsihar there is some operation on a circuitous route via Hailun.

In the south-west, towards Peking and towards the Mongolian frontier, two air routes branch from the town of Chiaoyang. The northern route connects trading centers with the strategic point of Linsi, and the southern covers the mountainous region of the Jehol Province, where railway "facilities" are few. This line can be extended to Peking to connect with the services of the Chinese National Aviation Corporation.

The M.K.K.K. started with Fokker SUs drawn from the Japanese company. Air Ministry returns show that a few months ago the fleet comprised :—

18 Fokker Super Universals	(Nakajima-built Jupiter 6) ..	6 passengers
2 Fokker F.7's	(3 Wright Whirlwinds) ..	8 passengers
6 Puss Moths	(Gipsy III)	2 passengers

The latest traffic statistics available are the year 1933 :—

Route.	Flown.	Passengers.	Goods.	Mails.
3,240 km.	1,677,780 km.	Over 16,000	236.25 Eng. tons	63.00 Eng. tons

The Nihon Koku Yuso Kabushiki Kaisha (or Japan Air Transport Co.), capitalized at Y.10,000,000, has been operating for a number of years, and is well established. Its fleet, according to latest available reports, is as follows :—

1 Avro 504 K.	(Rhone 9JB)	1 passenger
1 Dornier Wal.	(2 BMW 6)	6 passengers
7 Fokker F.7 B's	(3 Wright Whirlwinds) ..	8 passengers
13 Fokker Super Universals (some with floats) ..	(Nakajima-built Jupiter 6) ..	6 passengers
6 Nakajima P 1	(1 Nakajima-built Jupiter) ..	Mail
1 Salmson 2A 2	(1 Salmson 9Z)	1 passenger

Of the above further drafts may have been made to the Manchuokuo company. The company operates daily except Mondays, each way between Tokyo and Dairen, also twice daily on the Osaka-Fukuoka section. The through fare to Dairen is Y.151. One can leave Osaka at 06.30 and get to Dairen by 16.50 Or one may leave Tokyo at 09.30, reach Fukuoka at 16.00 and cross next morning (09.30) to the mainland. Seaplanes are used between Osaka and Fukuoka. A night mail service, Tokyo-Osaka, was started on November 1, 1933. A week-end summer service is run from Tokyo to Toyama. The subsidy of the N.K.Y.K.K. for 1933-34 was Y.2,010,000 (£205,100), compared with Y.2,374,950 (£242,340) in the previous year. The 1934-35 subsidy is to be considerably less. Extensions are planned (*a*) to Sapporo, in Hokkaido, by way of Sendai and Aomori ; (*b*) to Shanghai, 875 km. direct from Fukuoka, or with a shorter sea crossing of 470 km. from Quelpart Island ; (*c*) to Taihoko, in Taiwan, by way of the many islands. From March, 1929, to December 31, 1933, the company flew 9,600,000 km. and carried 49,148 passengers, about 100,000 kg. freight and a large amount of mails.

Three other companies operate regular services in Japan. The Nihon Koku Yuso Kenkyujo runs six return flights weekly between Osaka and Matsuyama. Its fleet up to recently was as follows :—

3 Hansa	(1 Hispano-Suiza 8A) ..	2 passengers
2 Japanese Navy 14 Hydro .	(1 Lorraine 2)	4 passengers
2 Japanese Navy 2 Hydro ..	(1 Napier Lion)	2 passengers

The Tokyo Koku Yusosha runs three return flights weekly on the short route from Tokyo down to Shimizu by way of Ito and Shimoda. Its fleet at a recent date was as follows :—

1 Aichi AB 1	(1 Lorraine 450)	2 passengers
2 Hansa	(1 Hispano-Suiza 8A) ..	2 passengers

A mail service is operated by the Asahi Teika Koku-Kai, a newspaper publishing company, between Tokyo and Niigata, with three return flights weekly. This company has a very mixed fleet, which, according to recent report, was as follows :—

1 Dornier Comet	(1 BMW 6)	4 passengers
3 Puss Moths	(Gipsy III)	2 passengers
1 Fokker C 5	(Napier Lion)	1 passenger
1 Kawasaki A 6	(1 BMW 8)	1 passenger
1 Kawasaki C 5	(1 BMW 8)	1 passenger
1 Mitsubishi T 12	(Napier Lion)	3 passengers
1 Monospar	(Two Pobjoys)	2-3 passengers
1 Ishikawajima R. 3 ..	(1 Cirrus 3)	1 passenger
1 Ishikawajima T. 3	(1 BMW 6)	1 passenger
1 Cierva Autogiro	(Genet Major)	1 passenger
2 Salmson 2AZ	(1 Salmson 9Z)	1 passenger

On September 6 the Asahi company commemorated the tenth anniversary of the flight by its aeroplanes across Siberia to Europe by flying one of its Japanese-built machines (no doubt a Kawasaki) with B.M.W. eight motor from Osaka, by way of Seoul to Peking (about 1,242 miles). People in Peking seem to have looked upon the flight as a friendly gesture, which again demonstrates the good-fellowship value of aviation.

A good idea of the extent of commercial operations in Japan is obtained from the following table, which covers five recent years :—

Year (April-March)	*Companies operating.*	*Route. Miles.*	*Flown. Miles.*	*Passengers.*	*Goods. (Eng. tons.)*	*Mails. (Eng. tons.)*
1929	3	1,892	745,088	3,285	7.64	10.95
1930	3	2,455	1,182,114	8,713	14.92	27.50
1931 (April to May)	5	2,722	1,219,532	7,675	29.55	36.55
1932 (April to May)	5	2,042	1,232,712	8,057	34.39	43.70
1933 (April to May)	4	1,929	1,220,325	11,415	63.84	96.29

Airplane Factory for Kwangtung

Shaokwan, a town in Northern Kwangtung connected with Canton by the Canton-Hankow Railway, has been selected as the site for the construction of an aircraft factory, where bombers, fighters and pursuit 'planes will be constructed.

The military authorities consider Shaokwan within easy reach of Canton and of Hankow upon completion of the Canton-Hankow Railway, which is depended on to supply raw materials for the construction of aeroplanes. Iron and steel will be provided by the new works to be constructed at Tung Long, four miles from Canton on the right bank of the Pearl River.

Extensive grounds on the outskirts of Shaokwan will be used for the aircraft factory, and a survey of the site will be undertaken by the Provincial Department of Reconstruction.

One hundred cadets will be enrolled in the autumn by the School of Aviation of the Army Air Corps here, and they will be instructed in mechanical and aeronautical engineering.

Machinery for the production of aircraft was ordered from several American firms through the air mission which recently visited the United States. The party included Lieut.-General Wong Kwang-yui, Commandant of the Air Force, Colonial Mei Lung-on, Director of the Aircraft Works, and Colonel Ting Chi-hsu, Wing Commander.

These air officers are on their way back to Canton from Europe and will arrive here in the early part of next month.—*Overland China Mail.*

Yunnan Rich in Minerals

One of the richest provinces in China in the matter of mineral resources is Yunnan, and although the tin mines in this district have been worked for centuries, there are still many deposits not yet tapped. Gold is also found in the district, and this metal is obtained from both mines and placers. Although the gold mines have been worked for a considerable period by primitive methods, the results are still very satisfactory, and with modern machinery and up-to-date methods it is believed that the yield would be larger.

Iron ore is found in numerous places in the province in the form of hematite, limonite, and magnetite, but so far no large scale operations have been started to exploit these deposits, which are worked mostly by farmers in the slack season. Antimony deposits are numerous, especially in the southern part of Yunnan. The brisk demand for antimony during the war led several capitalists to start large scale operations and most up-to-date methods were used. The output amounted to several hundred tons of antimony regulus, but since the war the companies have suspended operations owing to lack of demand.

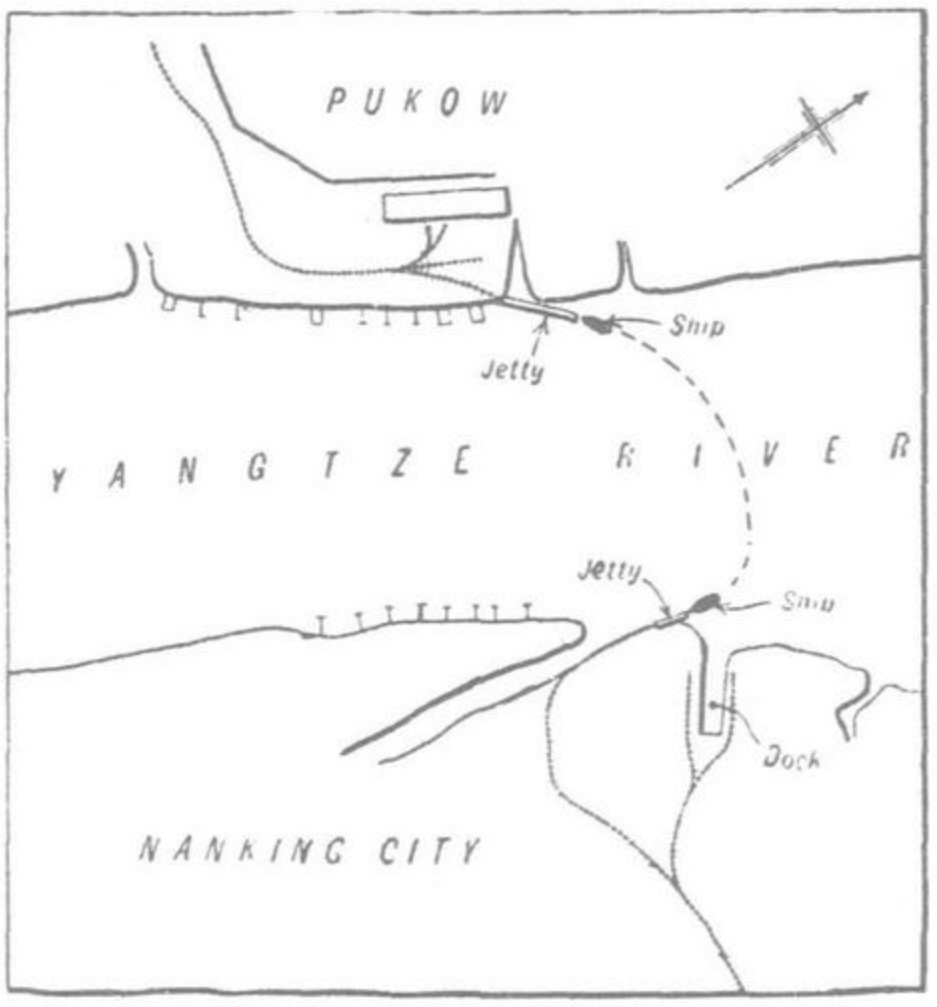
Asbestos is found at several places, and according to the Chinese Ministry of Industry, Shanghai, some years ago attempts were made by local capitalists to work the deposits. At the outset, a fair measure of success was attained, and quantities of the mineral were produced for export, but lack of capital forced the enterprises to discontinue operations.—*London Chamber of Commerce Journal.*

The Nanking-Pukow Train Ferry*

(The following is supplementary to a preliminary descriptive article on the Nanking-Pukow Ferry, which appeared in "The Far Eastern Review," July, 1933)

* * *

UNTIL October 22 of last year the important line of railway running from Peking—or Peiping, as it is now usually called—to Shanghai was interrupted by a break at the Yangtze River between Pukow on the left bank and Nanking on the right. The river at this point is about a mile wide and has a daily tidal variation of level of from 1-ft. to 3-ft. and a maximum variation over the year of as much as 25-ft. On the date mentioned the gap was filled in by means of a train ferry steamer, the *Changkiang* operating between two jetties, as indicated on the accompanying sketch map. The foundations were constructed and the steelwork of the jetties was erected by the Chinese Government Railways, who were responsible for the general plan. With this exception, however, the whole of the work involved in carrying out the scheme was entrusted to British firms by the Chinese Government Purchasing Commission, to whom Sir Alexander Gibb and Partners acted as consulting engineers. The steelwork for the jetties was rolled and fabricated at Middlesbrough by Dorman, Long & Co., Ltd., the operating machinery for adjusting the gradient of the approach spans to suit the river level being supplied by Thomas Broadbent & Sons, Ltd., of Huddersfield. The train ferry steamer was built by Swan, Hunter and Wigham Richardson, Ltd., under the supervision of Sir J. H. Biles & Co., who acted as consulting naval architects and engineers and who co-operated with Sir Alexander Gibb and Partners in the design of the embarking and disembarking arrangements. A 0-8-0 tank engine was constructed under the supervision of Messrs. Sandberg by the Hunslet Engine Company, Ltd., of Leeds, specially for operating the trains using the ferry. This engine crosses the river with the trains and performs the shunting movements on both banks.



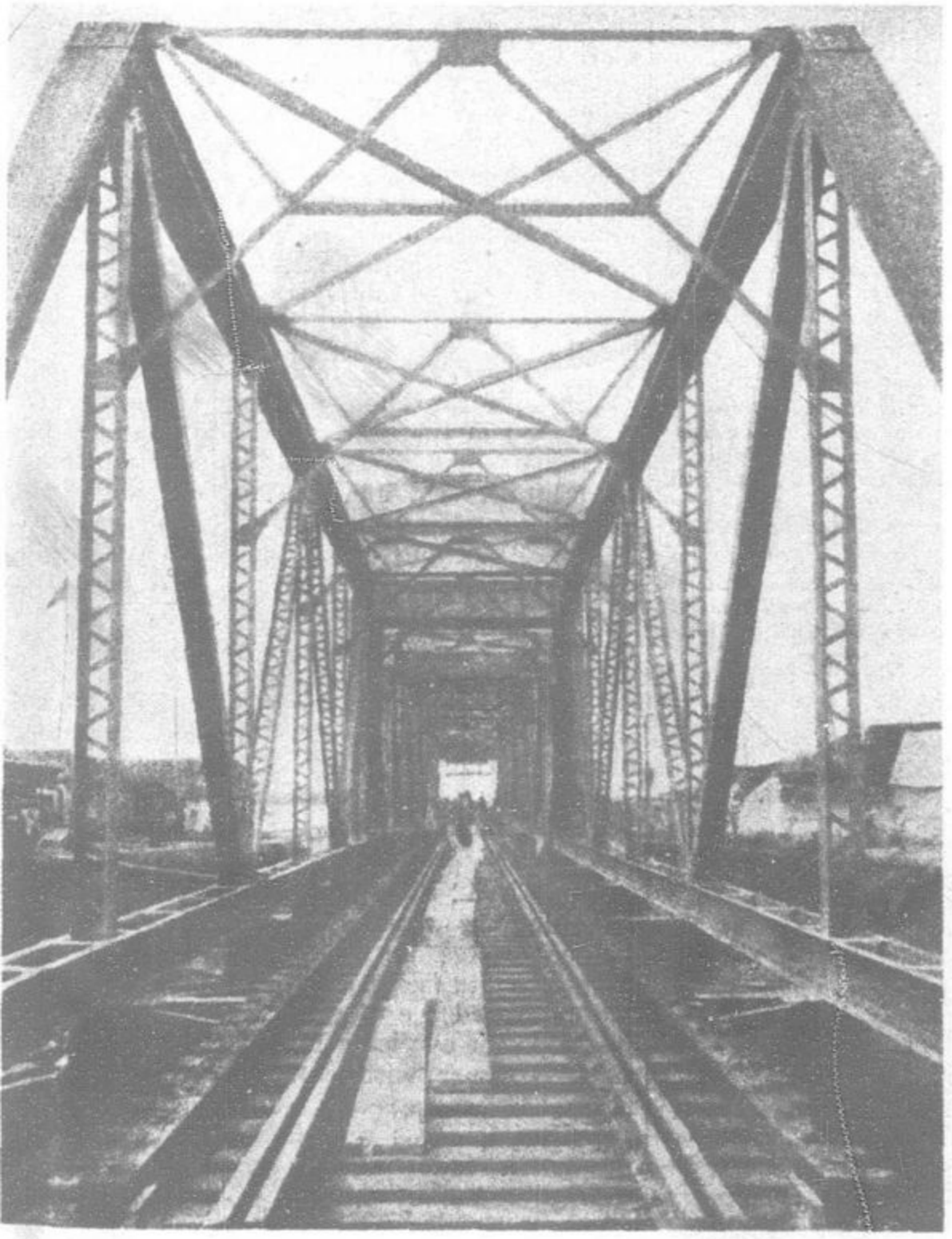
Route of the Ferry Steamer

The work had to be specially expedited to meet the wishes of the Chinese Government and to allow erection to be completed before the flood season. The first shipment of steelwork took place on January 7, 1933, and by the beginning of October in the same year the bridges and jetties were erected and ready for use.

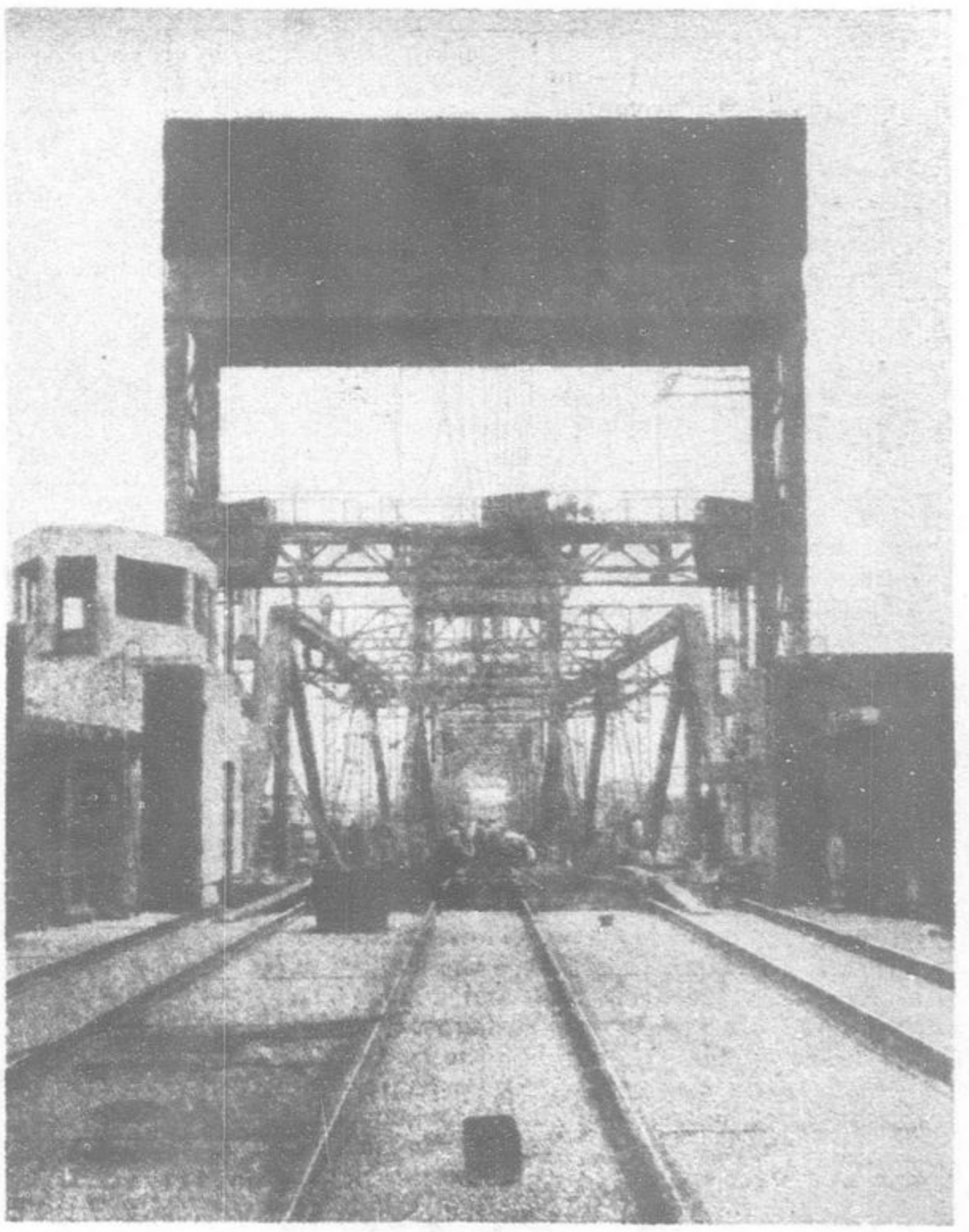
The Bridge Approaches

The bridge approaches are identical on the two sides of the river. Each

* *The Engineer*



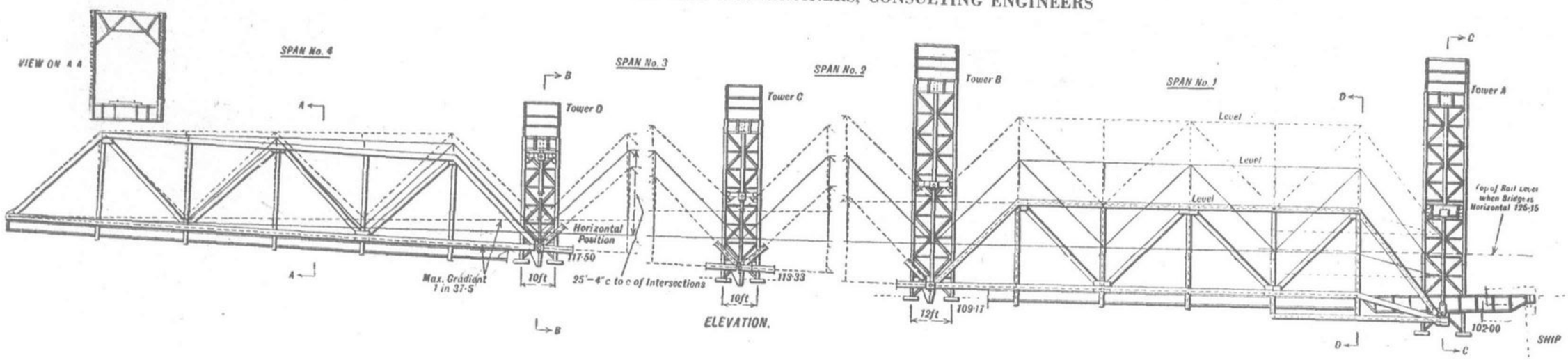
The Approach Spans looking towards river



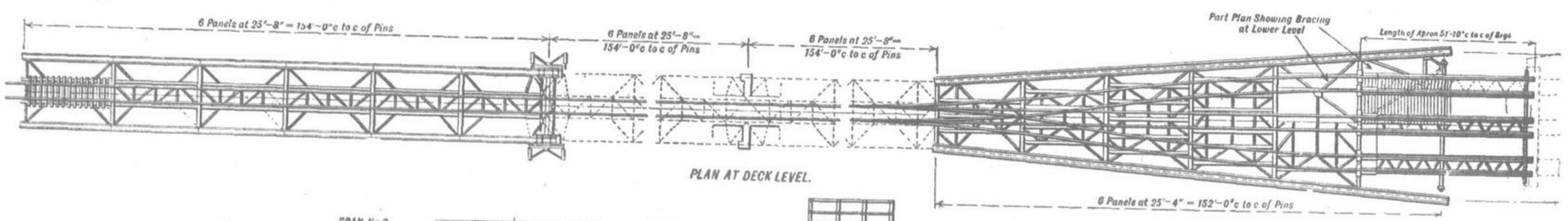
The Approach Spans from deck of Ferry Steamer

THE NANKING-PUKOW TRAIN FERRY—THE APPROACH SPANS

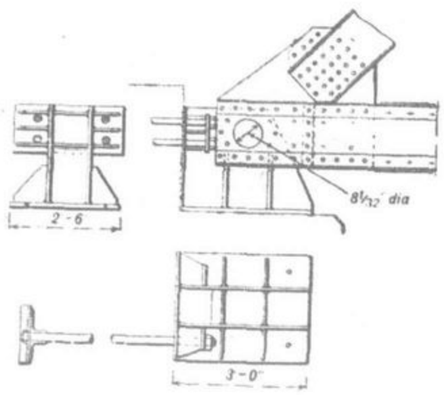
SIR ALEXANDER GIBB AND PARTNERS, CONSULTING ENGINEERS



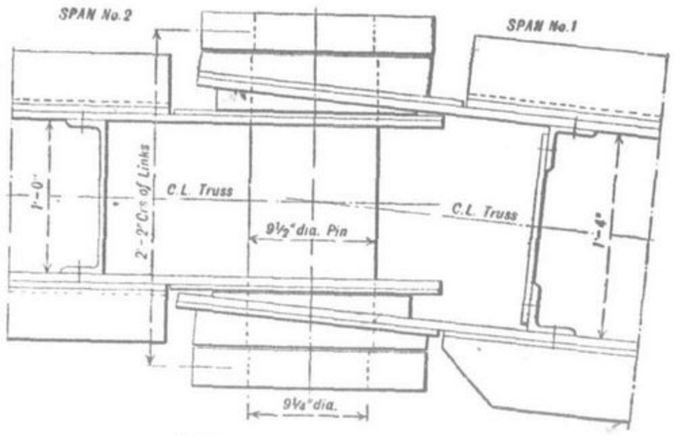
ELEVATION.



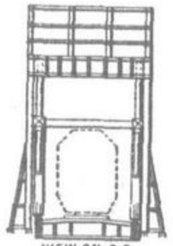
PLAN AT DECK LEVEL.



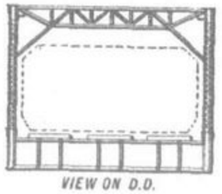
CONNECTION OF SPAN No 4 TO ABUTMENTS



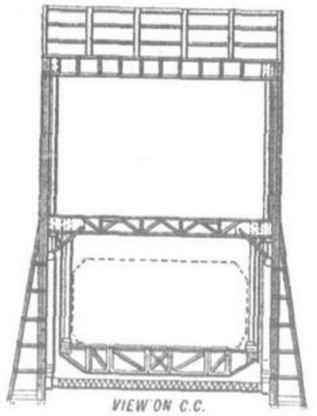
CONNECTION OF SPAN No 2 TO SPAN No. 1



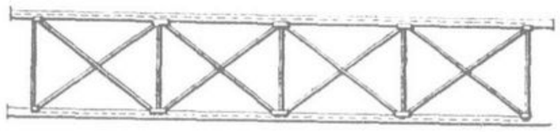
VIEW ON B.B.



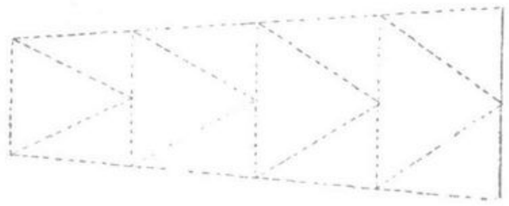
VIEW ON D.D.



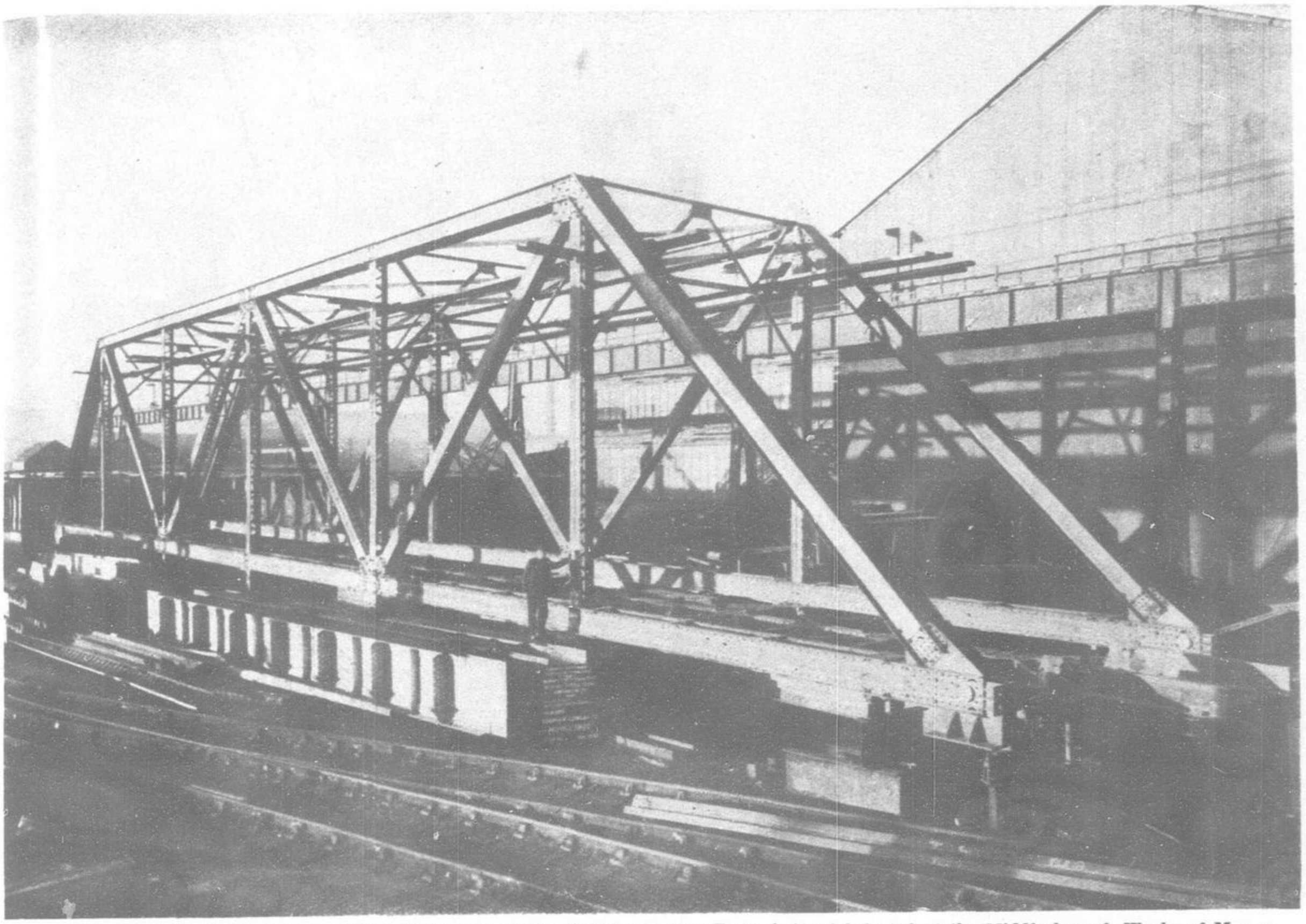
VIEW ON C.C.



PLAN SHOWING TOP LATERAL BRACING - SPAN No. 4

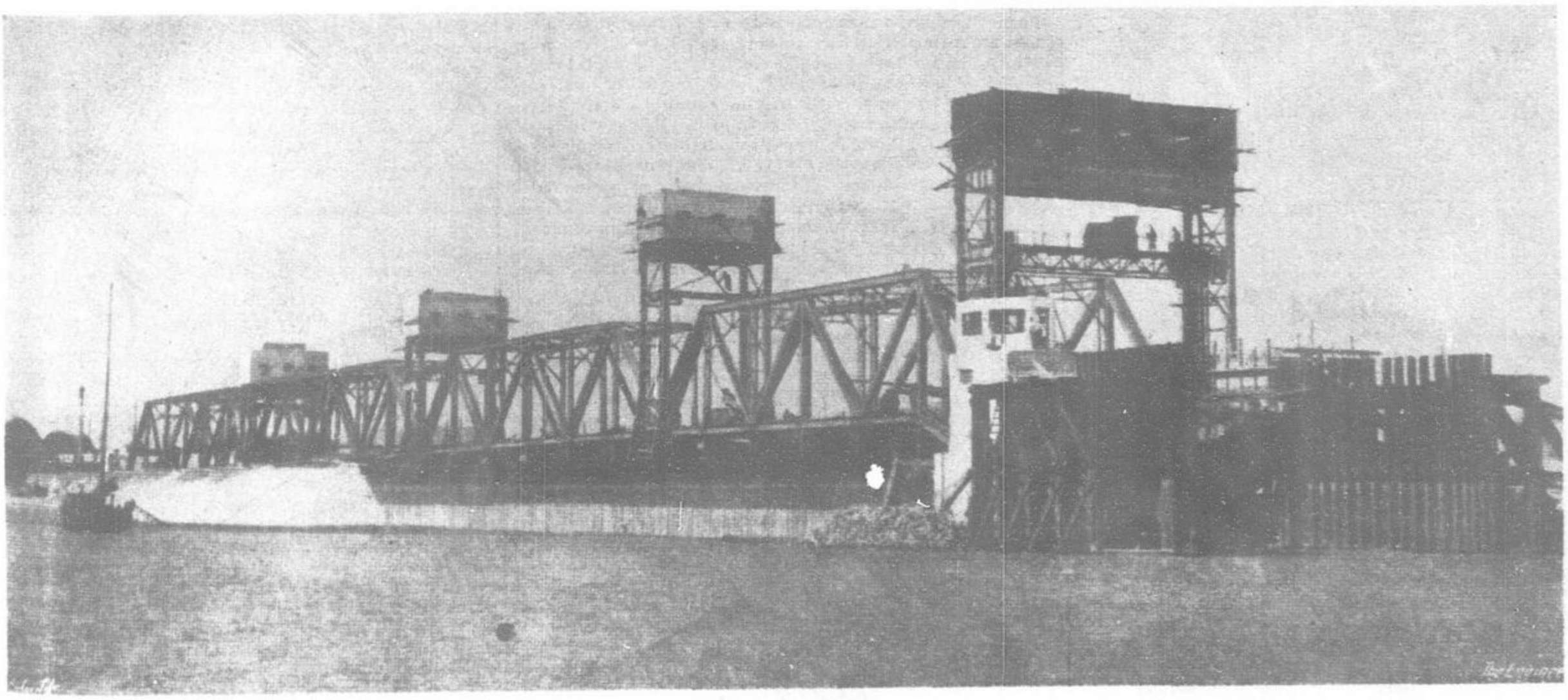


PLAN SHOWING TOP LATERAL BRACING - SPAN No. 1



One of the Movable Spans for the Bridge Terminals of the Nanking-Pukow Ferry being fabricated at the Middlesbrough Works of Messrs. Dorman, Long & Co., Ltd.

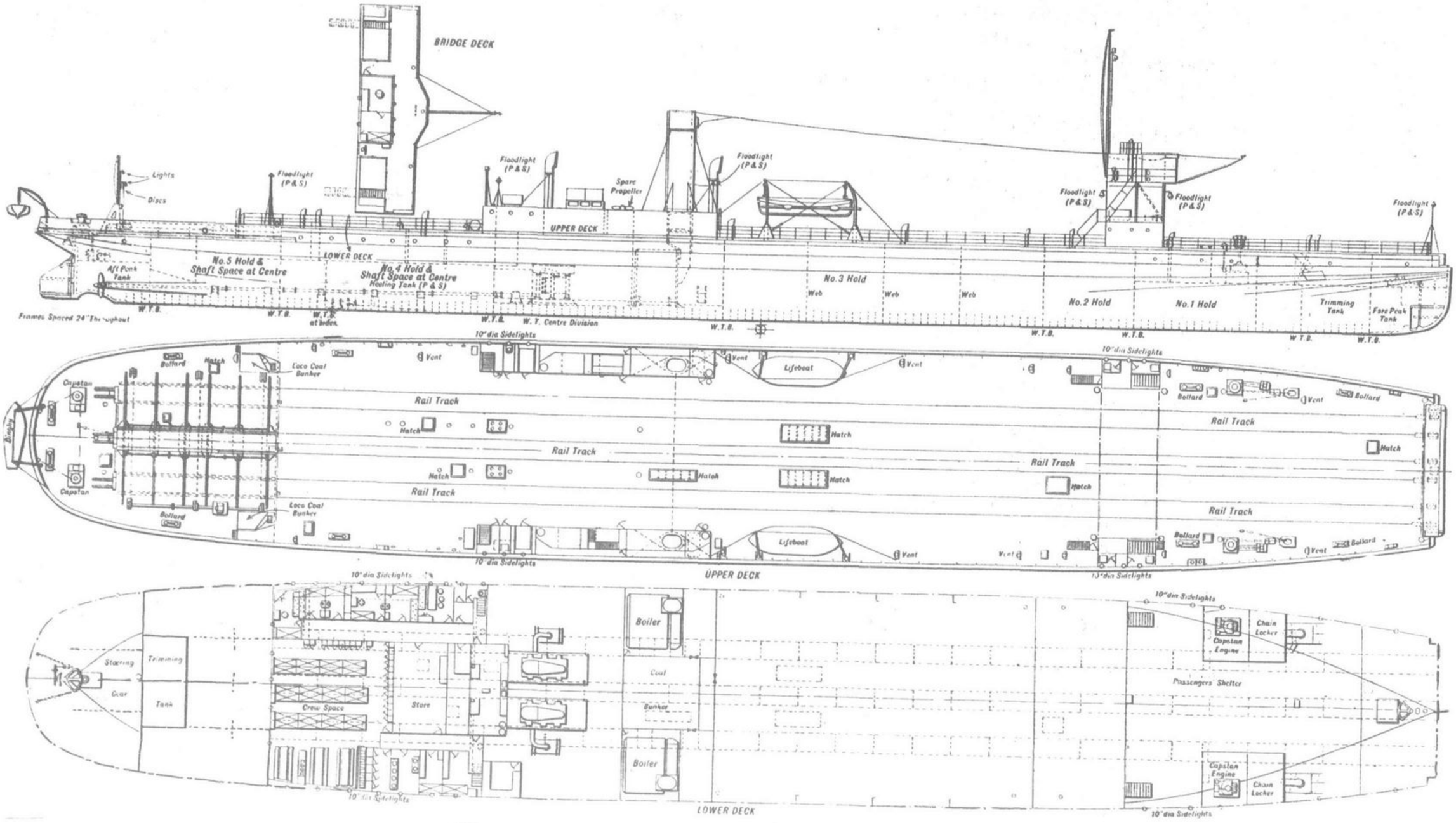
consists of four spans, three of 154-ft. and one of 152-ft., arranged in a line inclined in the downstream direction. A single line of railway is carried by spans Nos. 4, 3, and 2, which measure 20-ft. from center to center of their trusses. Span No. 1 the outermost, is flared out from 20-ft. to 44-ft. and carries three branching lines of track, whereby a train can be shunted in sections on to the three tracks on the ferry steamer's deck. The shore end of the fourth span is hinged to brackets mounted on a reinforced concrete abutment, while its outer end is pin jointed to the inner end of the next or No. 3 span. The third and second and the second and first spans are similarly connected by pin joints. The connecting pins are in each case coupled by a pair of long vertical links

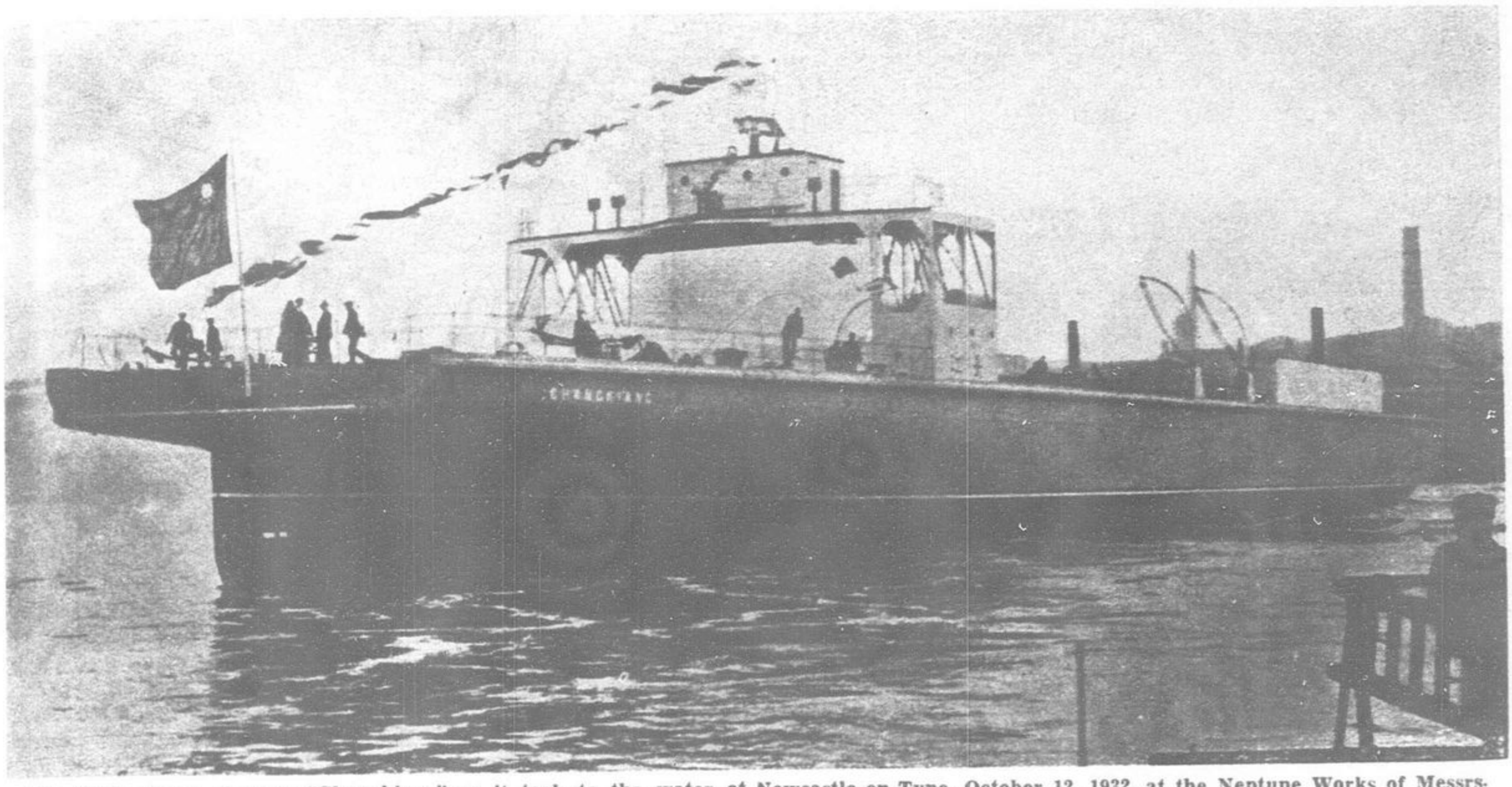


The Adjustable Approach Spans

THE NANKING-PUKOW TRAIN FERRY STEAMER "CHANGKIANG"

SWAN, HUNTER AND WIGHAM RICHARDSON, LTD., NEWCASTLE-ON-TYNE, BUILDERS





The Train Ferry steamer "Changkiang" as it took to the water at Newcastle-on-Tyne, October 12, 1932, at the Neptune Works of Messrs. Swan, Hunter and Wigham Richardson Ltd.

to a large nut within which a screw works. These screws depend from steel towers erected on piers rising from the river bed and can be rotated by motors and gearing on the top bracing members of the towers. At each tower the two nuts are tied together by a lattice structure carrying rollers which bear against guides running vertically up the inner faces of the tower legs. By these means the fourth, third, and second spans can be adjusted simultaneously to a uniform gradient of anything between 1 in 37.5 up to 1 in. 37.5 down. At the same time the first span is raised or lowered through equal amounts at both ends, it being deemed desirable in the interests of safety that at all settings of the other spans the first span should be horizontal. A total vertical movement of 25-ft. can in this way be given to the first span. From the end of the first span an adjustable apron carries the rails across on to the bow of the ferry steamer. This apron is designed to take up any change of level of the ferry steamer which may occur during loading or unloading. It may be raised or lowered to any inclination between 1 in 30 up and 1 in 30 down. When resting on the bow of the steamer the apron engages with a heavy cast steel guide which maintains the position of the steamer relatively to the apron. The apron is hinged at its shore end to brackets on one of the cross girders of the first span. It has a length of about 52-ft. Its support and movement relatively to the first span are obtained from rope purchases connecting points near the middle of its length with winding drums. These drums and the electric motor operating them are mounted on the travelling lattice work frame, which, as already noted, runs on vertical guides on the inside faces of the tower legs and which carries the nuts by means of which the span is raised and lowered. By this arrangement the apron is made to follow the vertical movement of span No. 1, without altering its initial inclination thereto, while at any level of the span the inclination of the apron may be adjusted by means of the rope purchases to any desired amount within the limits named above. Hinged and sliding rail joints connect the railway tracks on the apron with those on the steamer.

The Train Ferry Steamer

The *Changkiang* is a twin-screw steamer which was built and engined at the Neptune Works of Swan, Hunter and Wigham Richardson, Ltd. She has a length of about 372-ft. overall and an extreme width of 58-ft. 6-in. and is designed to carry a total live load of about 1,200 tons and a total deadweight of 1,550 tons. On the upper deck there are three clear lengths of car track, each 300-ft. long and each capable of accommodating seven wagons or coaches. The vehicles are shipped and unshipped at the forward end. The shunting locomotive by which the vehicles are moved off and on to the steamer is carried at the after end of the upper deck on a steam-driven traverser by means of which it can be moved horizontally across the deck to operate on any of the three tracks. Substantial buffers are provided aft of the traverser in line with each set of rails.

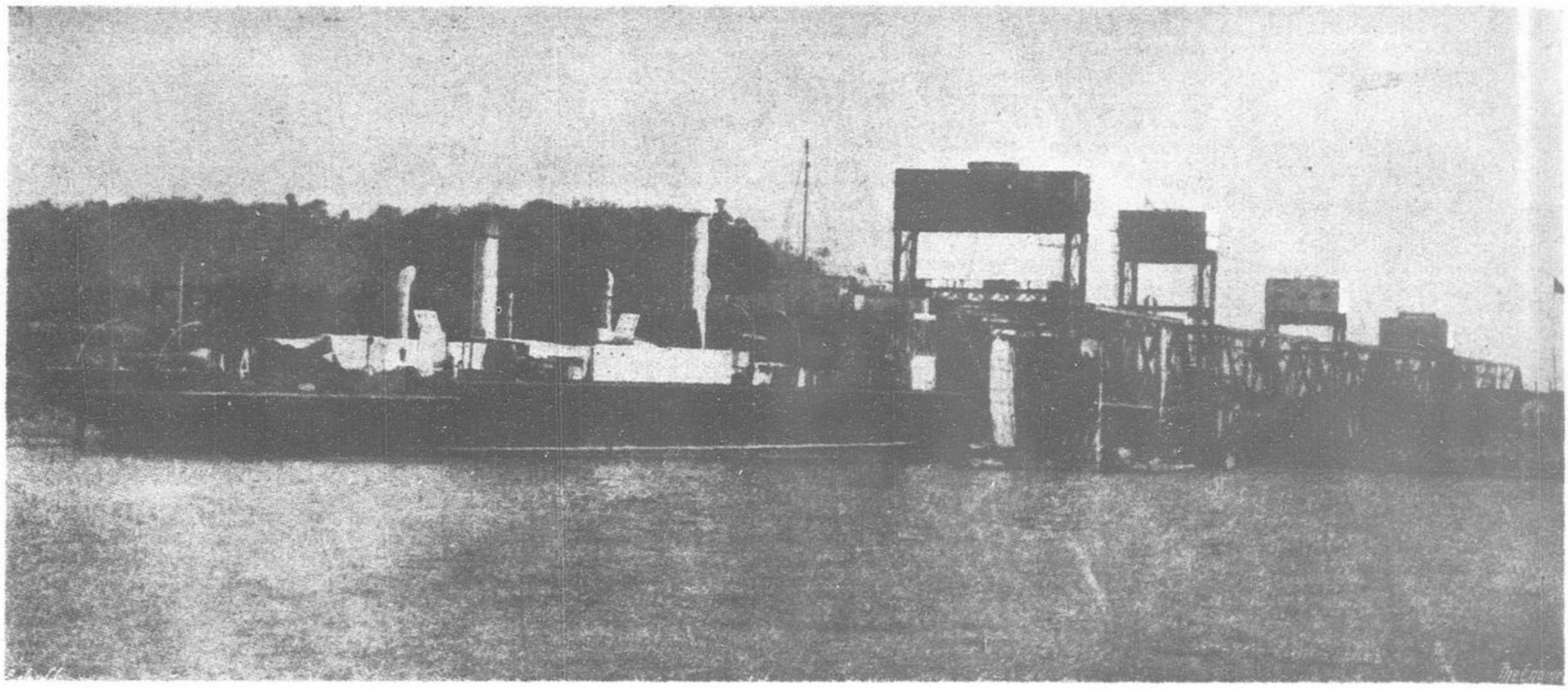
To facilitate berthing a bow rudder with independent steering gear is provided in addition to the after steering equipment. The propelling machinery is situated amidships, the casings being arranged at the sides of the upper deck in order to leave a clear space for the railway tracks. Between the two boilers a coal bunker is provided. The hull is very completely sub-divided by means of watertight bulkheads extending to the upper deck. Feed water is carried in a cellular double-bottom tank under the engines and water ballast in the forward and after peaks. In addition, there are trimming tanks forward and aft and heeling tanks on the port and starboard sides. Wooden fenders are fitted at the level of the upper deck and extend round the bow and stern.

The navigating bridge is situated at a level giving an unobstructed view above the trains and reaches across the full width of the ship. Day and night accommodation for the captain is provided on the bridge. The officers', engineers', and crew's quarters are situated on a lower deck aft of the engine-room. On the same deck forward a shelter is provided for passengers. The deck machinery includes Wilson-Pirrie steam steering gears forward and aft, both the gears being controlled by telemotor from the navigating bridge. Two steam capstans are arranged forward and two warping capstans aft. Flood-lighting is provided on the car deck and steam heating throughout the living accommodation.

The propelling machinery consists of two three-cylinder, triple-expansion, surface condensing engines supplied by steam from two single-ended Scotch boilers operating under the Howden forced draught system. The boilers are situated in separate stokeholds and have independent uptakes and funnels.

Data About the Nanking-Pukow Train Ferry

Supplementary to the foregoing the following details with regard to the operation of the Nanking-Pukow Train Ferry are



The Ferry Steamer berthed at one of the jetties

given in a recent number of the *Journal of the Association of Chinese and American Engineers:*

The total cost of the construction of the new Nanking-Pukow Train Ferry, including the construction and the materials of the bridges, wharves, electric supply station on two sides, etc., amounted to $310,000.00 Mex. plus £200,000, altogether approximately $3,800,000.00 silver.

Before the construction of the train ferry, the maximum tonnage of cargo transportation from north to south was about 40,000 tons per month.

Since the construction of the train ferry, the maximum tonnage of cargo transportation has been more than 60,000 tons per month. Daily one south-bound passenger train and three south-bound freight trains cross the Yangtze River and the same number of north-bound trains make the crossing. Each freight train can have twenty-one cars and each passenger train twelve cars.

Before the construction of the new train ferry, there were no classifications on the through freight traffic for cargo transportation from the Tientsin-Pukow Railway to the Nanking-Shanghai Railway. Generally the rate on all classes of freight was $2.50 per ton, this including all the expenses of loading and unloading on both banks, lighterage for crossing the Yangtze River, etc. For ordinary cargo transportation from Pukow to Hsiakwan the rate was more than $2.50 per ton, due to the irregular prices made by local transportation companies and coolies and boatmen.

The rate per ton for cargo transportation across the river has been fixed by the Ministry of Railways as follows:

First class cargo: $1.50; second class cargo: $1.35; third class cargo: $1.20; fourth class cargo: $1.05; fifth class cargo: $0.90; sixth class cargo: $0.75.

The highest income from both passenger and cargo transportation has exceeded $70,000.00 per month since the construction of the new train ferry.

TABLE OF REFUNDING THE CAPITAL AND INTEREST OF THE LOAN FROM THE BOXER INDEMNITY FUND FOR THE CONSTRUCTION OF THE NANKING-PUKOW TRAIN FERRY

Year	*Month*	*Payment for Construction Fund*	*1st Instalment for Payment of Material*		*Total*
			Capital to be Refunded	*Interest to be Refunded*	
1934	May	$147,133.19	—	—	$147,133.19
1934	June	—	$439,984.49	$65,999.61	$505,984.10
1934	Nov.	$218,573.19	—	—	$218,573.19
1934	Dec.	—	$440,000.00	$55,000.00	$495,000.00
1935	June	—	$440,000.00	$44,000.00	$484,000.00
1935	Dec.	—	$440,000.00	$33,000.00	$473,000.00
1936	June	—	$440,000.00	$22,000.00	$462,000.00
1936	Dec.	—	$440,000.00	$11,000.00	$451,000.00
Total		$365,706.38	$2,639,984.49	$230,999.61	$3,236,690.48

Year	*Capital Refunded*	*Interest Refunded*	*Average Amount of Capital and Interest to be Refunded per Month*	*Monthly Expenditure*
1934				
July-Dec.	$658,573.19	$55,000.00	$119,000.00	$16,000.00
1935	$880,000.00	$77,000.00	$ 79,000.00	$16,000.00
1936	$880,000.00	$33,000.00	$ 76,000.00	$16,000.00

Shipping Mill to China

Machinery for the complete equipment of a combined spinning and weaving mill for both cotton and wool has been put on board a Holt liner, the *Tieresias*, at Birkenhead Docks by Messrs. Platt Bros, & Co., Ltd., of Hartford Works, Oldham. It makes a cargo of 1,000 tons and has been providing work for hundreds of engineers and fitters at Oldham for several months.

This 1,000 ton cargo represents delivery of part of the orders which Messrs. Platt Bros. have received for three complete mills from the Department of Reconstruction of the Kwantung Provincial Government at Canton. It will be landed at Hongkong. The mills include opening, blowing, carding, preparing, and spinning machines and looms for a 10,000-spindle cotton spinning and weaving mill, and opening, carding, spinning, and doubling machinery for a woollen mill of 1,200 spindles. The machines are all of the latest type.

In connection with this order, it is recalled that it was not until 1895 that foreign countries could import machinery into China, and in the following year Platt Bros. equipped the Ewo Cotton Mills there for British owners. Other British mills have been erected in the meantime, but the Ewo concern is the only one which retains its identity, and the machinery which Platt's installed is still running satisfactorily after 38 years, working at twenty-four hours a day.—*Manchester Guardian.*

Water Power in China*

By Professor C. A. MIDDLETON SMITH, M.I.Mech.E., Dean of the Faculty of Engineering at the University of Hongkong

A CHINESE engineer from Canton recently informed me that the Siemens (China) Co., a German concern, had signed a contract for 22,500,000 dollars, Hongkong currency (equivalent to about £1,600,000), for electric power supply in the province of Kwangtung. Of this sum about twenty million dollars was to be used on a hydro-electric scheme, while the remainder was for a new steam station near Canton. I have been asked to carry out certain tests on the materials for the scheme, and the technical details have been explained to me; from what I have learned I am convinced that this is only the beginning of water-power development in China. Indeed, all over China the industrial revolution gathers momentum each year, and Western ideas in applied science are being rapidly adopted.

Concerning the financial arrangements for the scheme, local British commercial engineers say that their firms could not compete with the Germans on that score, and that only a government could finance the contractors. The British Government three or four years ago sent out an Economic Commission to study trade in the Far East, but it made the mistake of including only one engineer, *though the future trade field in* China must be for the products of engineering factories.

Practically all of the equipment necessary for power production in China must for many years be imported. In the interior transport difficulties are great. In the remote province of Szechuen, 200 miles east of Tibet, a 40 h.p. hydro-electric plant, coupled to a 25 kw., generator, supplied from stock by the General Electric Co., provides light for Tai Chien Lu. It took sixteen coolies nearly two months to carry one piece of the machinery on their backs from the nearest port, Yochow. They had to cross two mountain ranges, the passes of which were heavily covered with snow and ice. In some places the road had completely disappeared; in others there were precarious bridges.

Abundant Resources

China is well watered by many streams capable of producing electrical energy, a fact which the Chinese are beginning to realize. Among important waterways are the North and East rivers that flow into the sea near Hongkong and drain Kwangtung, of which Canton, the British trade base in the Far East, is the capital. The Cantonese have always had the reputation for being the most enterprising of the Chinese people, and the town is the center of a thickly populated district in which modern factories are spreading.

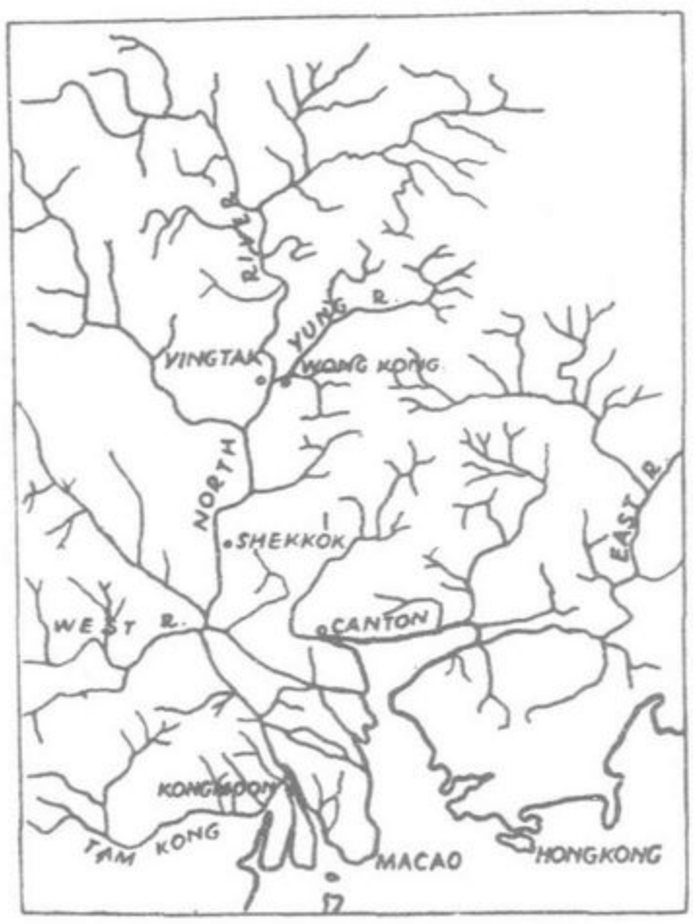
A student, Man Shu Sing, who obtained his B.Sc. degree in electrical engineering at Hongkong University, has played an important part in the hydro-electric development of Kwangtung. He was appointed chief electrical engineer of the Department of Reconstruction for Kwangtung Province and chairman of the Hydro-Electric Commission that reported on the utilization of the water-power of one of the smaller streams feeding the North river.

The report points out that: "Kwangtung is rapidly developing as a great manufacturing province, and consequently the demand for electric power increases. As there is a scarcity of coal deposits in the province, the only way to meet this increasing demand for power is to utilize as much as possible the abundant water-power resources of the province." The report goes on to explain that such is the aim of the Kwangtung Department of Reconstruction. In 1933 electrical, civil and geological engineers under the supervision of Man Shu Sing inspected the Yung river, about 100 miles (in the interior of Kwangtung) beyond Canton. The Yung river has a drainage area of about 1,500 sq. miles, and an average record of eleven years gives the annual rainfall as 100-in. The average flow of the river is 5,500 cu. ft. per sec.; it has been as high as 20,000 and as low as 1,035.

Details of the Scheme

The scheme which has been evolved provides for the construction of a gravity-type dam across the Yung river. The height from the foundations will be 140-ft. The dam is to be of reinforced concrete, sand and granite being available on or near the site. The length of the crest will be about 600-ft.; the width at the top 20-ft. and at the base 93-ft. The narrow lake so created will be 11.5 miles long, with a storage capacity of 1,576 million cu. ft.

The initial plan was to draw 5,000 cu. ft. of water per sec. from the lake which, under a gross head of 119-ft., will develop 40,000 kw. Four vertical turbines with 10,000 kw, 11 kv. 50-cycle alternators will be installed. Double-circuit 110 kv transmission lines supported on 70-ft. lattice-steel towers spaced 750-ft. apart are to be run to the substation at Sai Chuen, 90 miles away, on the outskirts of Canton, where the voltage will be stepped down to 3,300-volts for distribution.



The Kwangtung Drainage Area

In many electrical schemes in China the economic prospects have in the past been ruined by mismanagement and by the appointment (through influence) of incompetent Chinese engineers. I am more sanguine as to the future than many of my own countrymen in China, as twenty-two years' experience in Hongkong University make me believe that the younger generation of Chinese, especially those trained in applied science, have a very different outlook and are capable of doing fine work.

Much of the travelling in China is done on the long inland waterways, and, especially to non-technical minds, it seems such an obvious advantage to transform the "white coal" into electrical energy.

Another scheme for water-power development relates to the Yangtze, which is navigable for 600 miles by ocean-going steamers. It has many feeders, and all over the basin the main traffic is by water. At the coast the annual mean discharge is over one million cu. ft. of water per sec.—more than four times that of the Mississippi. In one section of 150 miles the fall is about 45-ft. per mile. Dr. Sun Yat-sen published a vague but grandiose scheme of development in which he suggested enormous dams and locks in the gorges, about 1,200 miles from the sea. This scheme, however, would appear to be impracticable on account of its cost, and because of the distance from any industrial centers. Nevertheless, there are great possibilities of utilizing some of the tributaries of the Yangtze, and the problem is, technically, quite as interesting to-day as was that of Niagara.

An International Commission of experts on water power is needed to prepare data, and to give advice, as to the most expedient manner of utilizing the Chinese rivers. At the same time, steps could be taken to overcome the risk of flooding.

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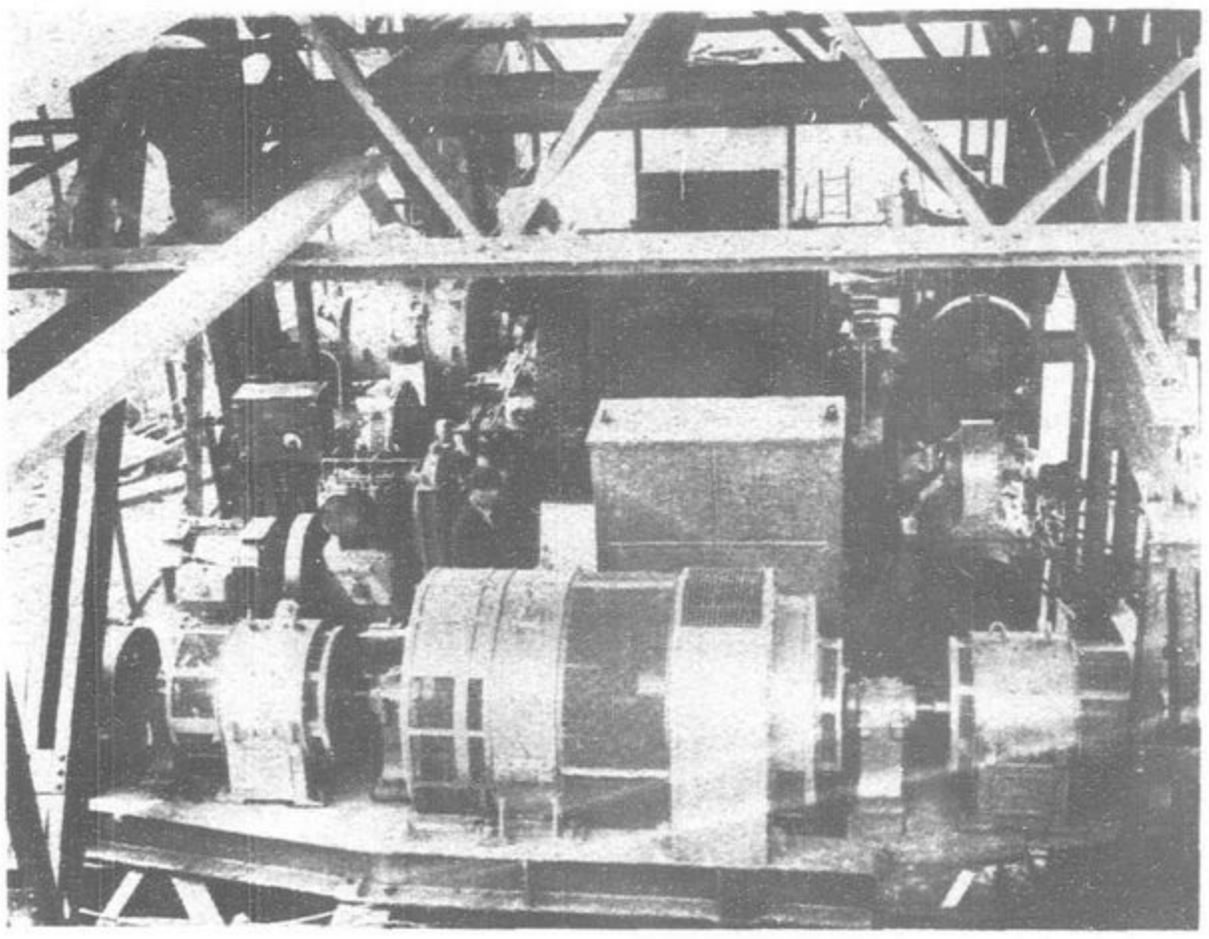
* *The Electricity Review*

Electrically Operated Excavators

THE recent installation of a nine cubic yard shovel excavator in the new iron-ore bed at Corby, Northamptonshire, which is being opened up by Messrs. Stewarts & Lloyds, Ltd., in connection with their new tube rolling mills, is of interest, as hitherto few excavators of very large capacity have been manufactured in England.

The excavator was built by Messrs. Ransomes & Rapier, Ltd., of Waterside Ironworks, Ipswich, and is fitted with electrical equipment manufactured by The British Thomson-Houston Co., Ltd., Rugby. It is of massive and rugged construction as will be seen from the accompanying illustrations, and weighs some 600 tons. It has a dumping height of 70 feet, and a radius of 101 feet, thus enabling a cut of 55 feet to be maintained without rehandling the deposited material.

The excavator is electrically operated on the Ward Leonard system, and all clutches and brakes are air-operated, the air being under the control of magnetically operated air valves, which are in turn controlled from the driver's cabin. As a result, all the motions can be operated by one driver with little physical effort.



The B.T.H. electrical equipment on the excavator

The power supply to the excavator is alternating current at 3,300-volts, three-phase, 50-cycles, through a flexible trailing cable to a collector unit on the revolving superstructure, and thence to a high tension control cubicle. Here the current divides through isolating switches, a main supply going to the auto-transformer starting switches for the synchronous motor, which drives the main Motor Generator Set ; and an auxiliary supply going through high tension fuses to a 50 kva. step-down transformer supplying current at 440-volts, three-phase, 50-cycles, to the auxiliaries and lighting circuits.

The main B.T.H. motor generator set comprises five machines, namely, a 435 kva. synchronous motor, a 275 kw. generator for the hoist motion, two 75 kw. generators for the slew and crowd motions, and a 20 kw., 125-volt exciter. All these machines are mounted on a welded steel baseplate, arranged for three point support, to avoid distortion should the superstructure deflect slightly under the strains imposed during operation. The generators are all designed with special characteristics for Ward Leonard control of the main motors by varying the excitation on the

(Continued on page 560)

The excavator in operation at Corby

British Equipment Supplied for Japanese Electrical Plants

HIGH permeability cast steel is extensively employed in the manufacture of all types of direct current electrical plant and an interesting example of its use is provided by the 8-2,000 kilowatt (equivalent to nearly 22,000 horse-power) motor converters manufactured and supplied by Messrs. Bruce Peebles & Co., Ltd., Engineers, Edinburgh, for the Tokyo and Kobe electrification schemes of the Japanese Government Railway Administration.

Three of these massive machines are illustrated in the picture (Fig. 1) of the Ofuna Substation from which some idea of their size will be gathered when compared with the attendant standing beside one of the machines. There are now four motor converters in the Ofuna substation and a further four equipments are located in the Ninomiya substation, these substations being situated at some considerable distance apart.

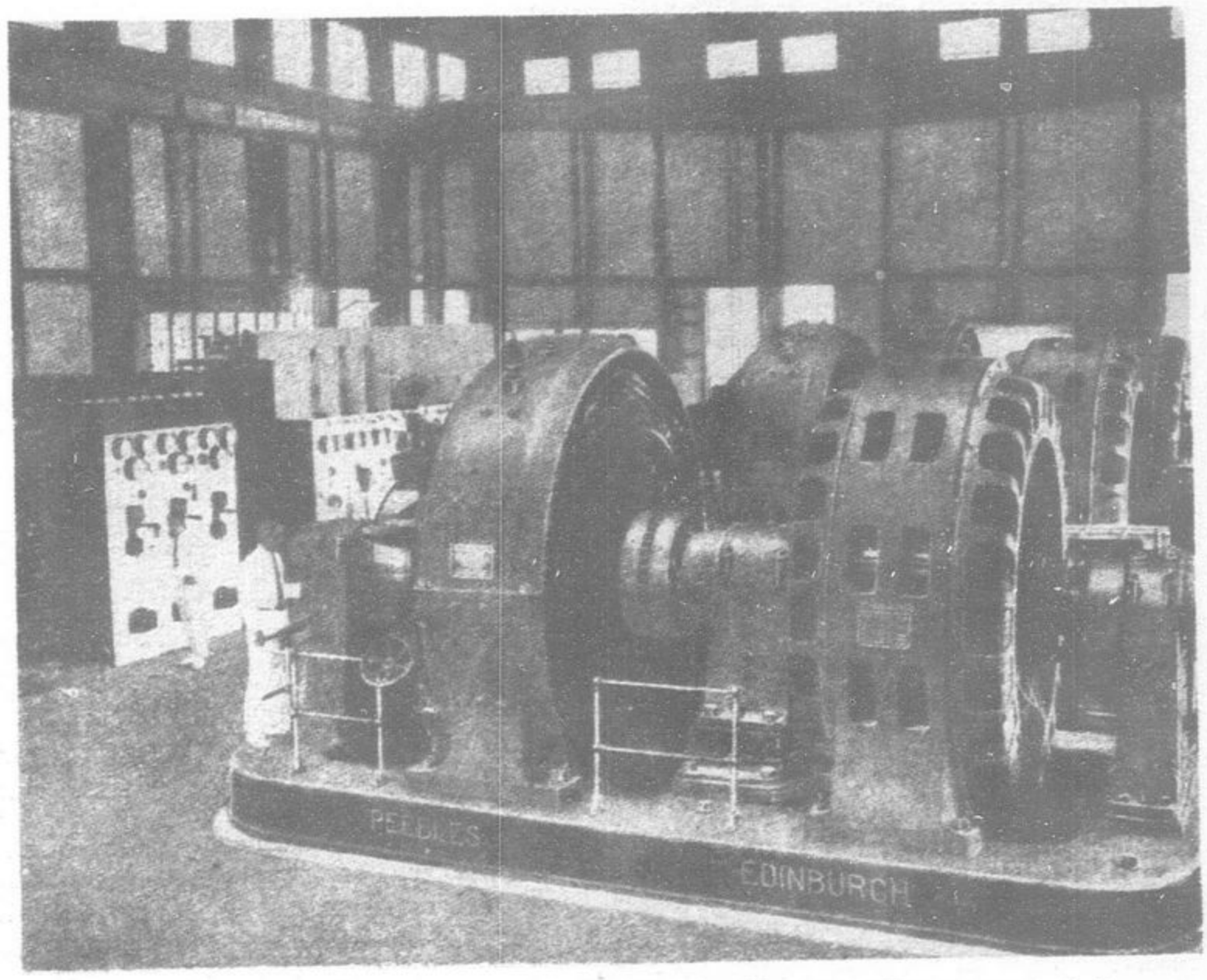


Fig. 1.—Interior of the Ofuna Substation of the Japanese Government Railways showing three of eight 2,000 kw (1500-volt D.C.) Motor Convertors

These motor converters have for their object the conversion of high tension alternating current, which is the most economical form of electric power for transmission over long distances, into direct, or continuous, current suitable for the trains.

Actually in the case of the Japanese railways, power is generated in the form of alternating current at hydro-electric power stations situated at well over 100 miles from the railways and stepped up to 133,000-volts by means of transformers. It is then transmitted by overhead lines to the motor converter substations located at the most convenient positions on the railways, where the voltage is stepped down and converted into 1,500-volts direct current for the trains.

It will be noted that the Japanese railways use direct current pressure at 1,500-volts for the trains, and it is of interest to record that the motor converters were the first to be built for giving high tension direct current from machines constructed with single commutators. Many novel features were embodied in the design of the machines, the commutators and direct current field systems being of quite a special construction. Fig. 2 shows the steel magnet frame and constructional features of the field system. The complete frame weighs about 17 tons and is approximately 12 feet in dia. Quite apart from the high operating direct current voltage, the demands made upon the motor converters by the very nature of the traction load are particularly severe, but the machines have proved themselves thoroughly reliable under the heavy loads which occur in such service.

Each motor converter is designed to develop a continuous output of 2,000 kilowatt and to carry overloads up to 4,000 kilowatt (equivalent to nearly 5,500 horse-power) for varying periods of time, the normal speed being 375 r.p.m. The machines are of the self-synchroniz-

(Continued on page 560)

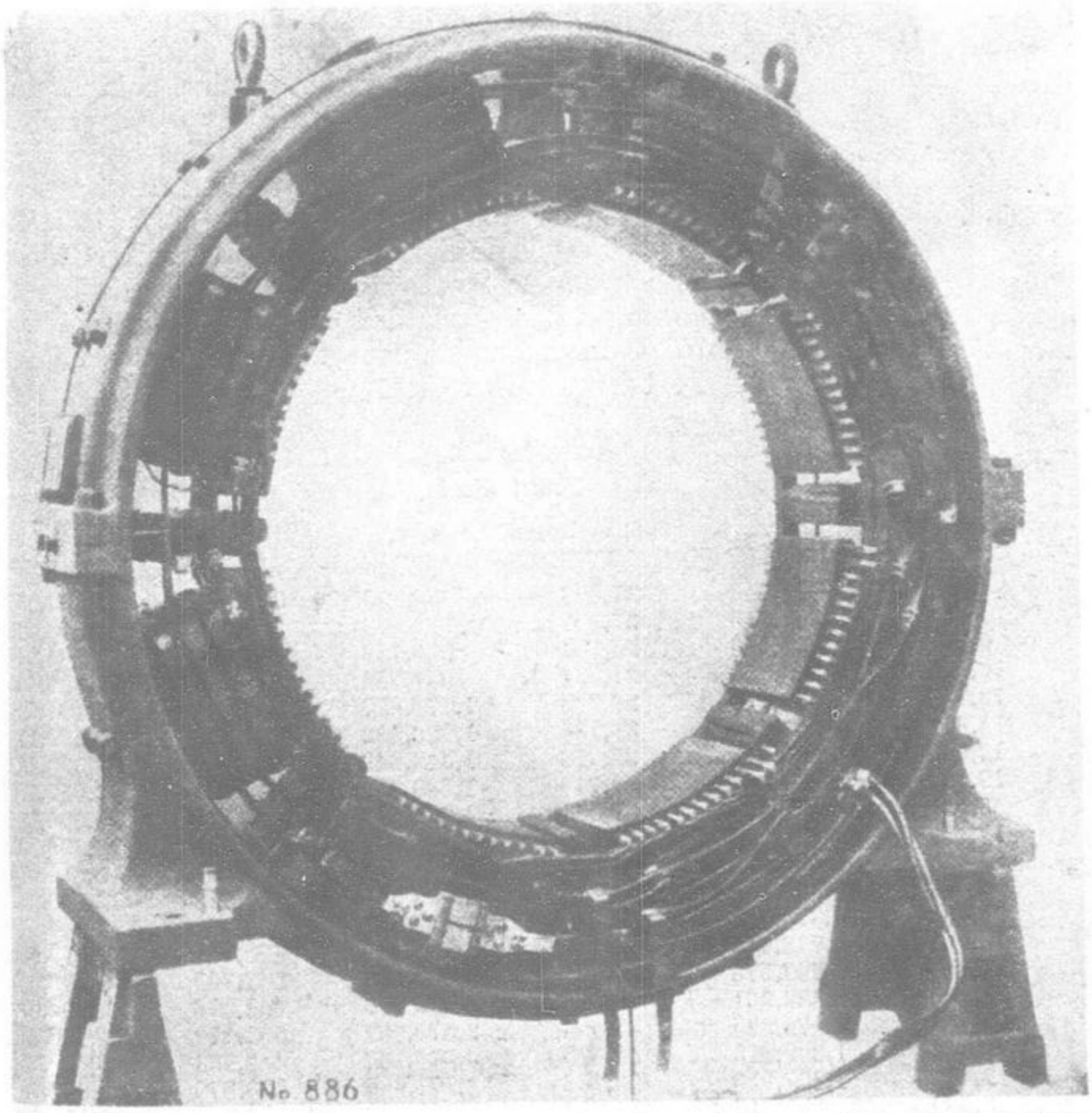


Fig. 2.—Steel Magnet Frame showing constructional features of the Field System

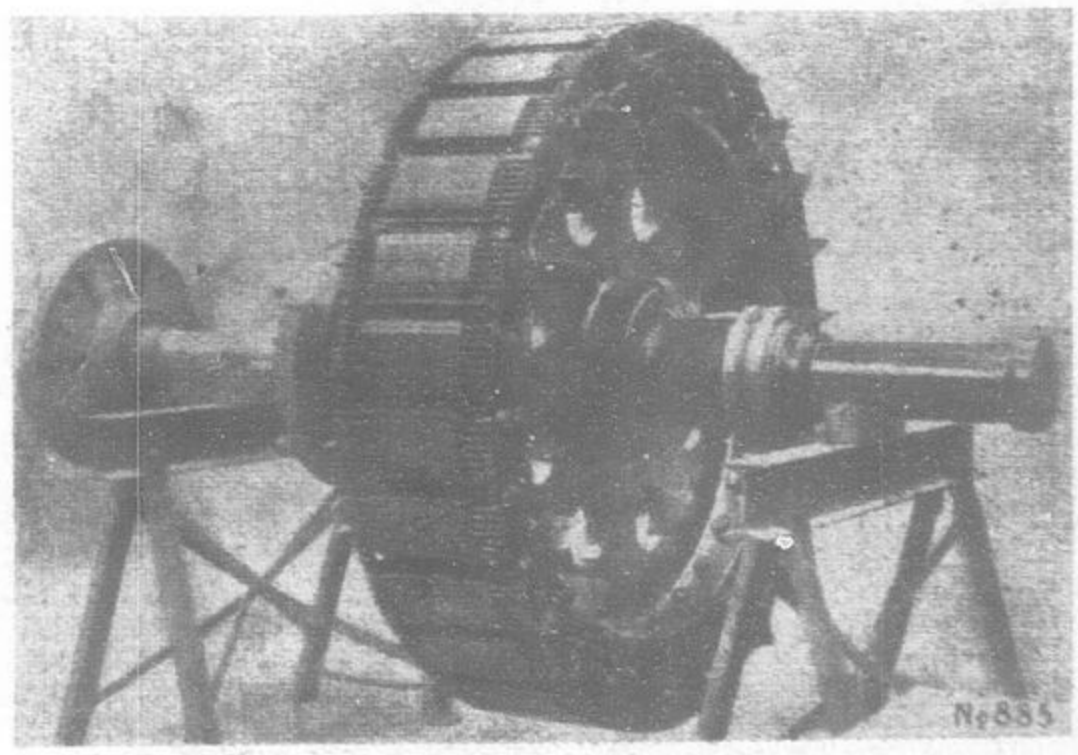


Fig. 3.—Magnet wheel for a 325 kw. Alternating Current Generator

State Plans for Industrial Development*

Woollen Mill Project

WOOLLEN piece-goods nowadays are no less important as clothing material than cotton piece-goods, but the weaving of woollen cloth is quite a modern industry in China. In olden times the Chinese never imagined that wool could be spun into yarn and woven into fabrics. Probably their failure to appreciate the value of wool was due to the fact that there was always an abundance of cotton, silk, and flax for manufacturing fabrics suitable for all classes of people and all seasons of the year, whereas in Europe wool was the principal fiber available for making cloth.

The first woollen-mill in China was established at Lanchow, capital of Kansu, in the early 'seventies, under the auspices of the late Tso Chung-tang, then Viceroy of Shensi and Kansu. The second enterprise of this kind was the Tsingho Mill, Peiping, established in 1900. Succeeding years witnessed the opening of several other mills, of which the better known were the Jih Hwei Mill, Shanghai, and the Hupeh Felt and Woollen Cloth Factory, which was an enterprise of the Hupeh Provincial Government, of which Viceroy Chang Chih-tung was then the head. The industry showed practically no progress until 1923, when the Yu-ching-teh mill started operations in Harbin. Since then two more large factories have been established—the Haiching Mill, Tientsin in 1926, and the Chang Hua Woollen Textiles Co., Shanghai, in 1930.

At present the number of woollen-cloth mills in China is about 20, but they are mostly small concerns, incapable of handling large-scale production with the exception of the Army Woollen-Cloth Mill, Peiping, the Yu-ching-teh Factory, Harbin, the Haiching Mill, Tientsin and the Chang Hua Mill in Shanghai. The total annual output of piece-goods from these mills is only about $4,000,000 (of which about three-quarters is contributed by the big four), a figure which looks very insignificant compared with China's import of woollen textiles of more than $20,000,000 a year.

Many Chinese provinces are noted for their wool production—Suiyuan, Sinkiang, Ninghsia, Tsinghai, Outer Mongolia, Jehol, and Chahar, the annual total amounting to more than 800,000 piculs, an adequate quantity for domestic requirements. It is only because of the absence of large mills able to absorb all the wool produced in these North-Western provinces that China has to be dependent upon the foreign supply of woollen textiles.

With a view to encouraging the woollen industry in China, the Ministry of Industry has planned to establish (among other factories) a woollen-mill larger than any existing concern. Investigators were sent to the Northern provinces to study conditions of wool supply, and in the meantime a detailed scheme of factory equipment was drawn up. Particulars of the wool trade and the suggested plans of the Ministry concerning the State mill are as follows:—

* *Chinese Economic Journal*

Wool Production

Sheep and camels are found in nearly all parts of North-Western China, and everywhere in Suiyuan, Sinkiang, Ninghsia, Tsinghai, Kansu, Shensi, Outer Mongolia, Jehol and Chahar. The annual clipping of wool from these animals is estimated as follows:

	Sheep (*Piculs*)	*Camel* (*Piculs*)
Outer Mongolia	150,000	—
Jehol	23,950	70,000
Chahar	15,050	—
Suiyuan	20,000	—
Sinkiang	140,000	35,000
Ninghsia	10,000	—
Tsinghai	120,000	—
Kansu	80,000	—
Shensi	50,000	—
Hopei	5,000	200
Total	614,000	105,200

The wool consumption of Chinese factories, however, is much less than the quantity available. The Yu-ching-teh absorbs only about 100,000 piculs annually, and the Haiching and the Army Woollen Cloth Mill about 20,000 and 30,000 piculs respectively. The Chang Hua is a large prospective purchaser, but being a new establishment at present takes only approximately 8,000 piculs a year. With regard to the wool used by rug factories in Peiping, Tientsin, Paotow, Ninghsia and Shensi, the annual consumption cannot exceed 100,000 piculs, though there are no statistics available. It is quite safe to say that little more than one-fourth of China's wool supply is taken by domestic factories, the balance being exported. The following table, compiled from Customs returns, furnishes details of China's annual exports of sheep wool, goat hair, and camel wool from 1912 to 1933:—

	Sheep Wool		*Goat Hair*		*Camel Wool*		*Total*	
	Piculs	*Hk. Tls.*	*Piculs*	*Hk. Tls.*	*Piculs*	*Hk. Tls.*	*Piculs*	*Hk. Tls.*
1912	264,733	5,662,885	20,000	444,642	27,843	756,323	312,576	6,863,850
1913	280,262	5,487,543	11,685	372,335	33,007	796,579	324,954	6,656,455
1914	301,358	6,658,962	9,787	330,108	25,001	695,738	336,146	7,694,808
1915	377,715	11,128,652	10,264	313,263	31,034	954,554	419,013	12,396,469
1916	334,536	10,698,681	13,030	452,177	29,783	1,070,827	376,349	12,194,665
1917	339,354	10,533,020	13,641	469,430	33,734	1,298,002	396,729	12,300,470
1918	318,036	10,276,772	12,606	419,110	38,318	1,542,849	368,960	12,238,731
1919	365,826	11,609,979	19,686	658,736	39,779	1,688,802	425,291	13,957,516
1920	103,713	3,091,081	8,351	223,952	39,041	1,729,103	151,105	5,044,136
1921	462,936	11,317,114	19,779	688,507	28,819	1,292,569	511,534	13,298,190
1922	507,597	12,892,537	15,258	496,773	60,582	2,245,327	583,437	15,634,637
1923	352,109	10,079,102	16,486	541,305	55,618	2,259,521	424,213	12,879,928
1924	485,320	14,040,672	25,290	1,313,167	37,950	1,990,635	548,560	17,344,474
1925	426,127	14,076,550	23,252	1,918,945	40,732	2,579,359	490,111	18,573,854
1926	208,433	6,942,831	11,535	797,578	27,831	1,992,493	247,799	9,730,902
1927	360,169	12,161,211	29,635	2,323,361	41,524	3,608,406	431,328	18,091,978
1928	486,341	15,813,281	24,234	2,078,395	41,595	3,575,057	552,170	21,466,733
1929	376,537	10,319,532	18,926	1,800,413	53,520	4,570,187	448,983	16,690,283
1930	195,391	5,331,575	12,439	1,337,016	22,756	2,271,806	230,576	8,940,397
1931	239,942	7,569,989	5,562	533,317	19,324	2,077,602	264,828	10,180,909
1932	34,212	1,209,890	10,347	747,923	16,416	1,397,290	60,975	3,354,103
1933	225,261	739,595	15,807	1,026,336	15,279	1,172,856	256,347	2,938,787

The wool export shown in the above table was not sufficient to balance the import of woollen textiles, especially during the past decade, as evidenced by the following figures, representing the value of imports of woollen fabrics since 1912 :

	Hk. Tls.		*Hk. Tls.*
1912	3,887,322	1913	4,879,281
1914	3,306,047	1915	1,729,865
1916	2,293,558	1917	3,676,815
1918	3,201,329	1919	3,614,055
1920	4,790,512	1921	7,407,232
1922	8,793,707	1923	19,042,413
1924	17,692,639	1925	15,509,013
1926	29,362,064	1927	17,678,463
1928	36,514,604	1929	35,244,013
1930	18,450,738	1931	26,801,176
1932	22,111,680	1933	21,416,664

Main Sources of Supply

Mongolia and Sinkiang provide supplies of camel wool, many Mongols raising camels exclusively for their wool. These animals are not used as beasts of burden, and are grazed throughout the year. The best wool is clipped in March and April. Wool is also taken from caravan camels, but owing to the mixed character of the goods they carry and the fact that they are given scant attention, their wool is very coarse and of little commercial value, but is used largely by the natives in making rugs and caps. The poorest quality is that combed from dead camels, which sells at a price five times less than that of fine wool. Clippings from the back and shoulders are usually coarse, the finest wool being combed from the belly.

There are many varieties of sheep wool—*chun mao* or " spring " wool, *chiu mao* or " autumn " wool, *hanyang mao* or " cold " wool, Sining wool goat's wool and lamb's wool. The *chun mao*, also known as *chua mao* or " combed " wool, is a product of Inner Mongolia, Hopei, and Honan, and sells at over $40 a picul. The fibre is between two and three inches long, and being fine and elastic, is peculiarly good for weaving serge, fine woollen cloth, and camlet. The *chiu mao* is collected during autumn, the chief places of production being Hopei, Shansi and Shensi, where it is sold at over $30 a picul. Autumn wool is much inferior in quality : the fibre is short and stiff, and is only fit for weaving carpets and worsteds. The *hanyang mao* is chiefly produced in Honan and Shantung, and is considered the best among the different grades of China wool. The fibre is fine, long, white, bright, and elastic, and suitable for weaving fine cloth. Sining wool is a product of Tsinghai, Kansu, and Suiyuan, and is also known as *tao mao*. The fibre is fairly long, and the color white and bright, good for weaving worsteds. Goat's wool is produced in Yulin, Shensi province, and Tsinghai, and is either white or black. The fibre, being short and " sticky," is suitable for weaving hats and mufflers, and sells at about $50 per picul. Lamb's wool is a product of Chahar, Suiyuan, Hopei, and Mongolia. It is coarse and stiff, with yellowish fibre, only good for weaving coarse carpets and rugs.

The quality of wool also varies with the district from which it comes. An expert investigator was sent by the Ministry of Industry to Suiyuan, Chahar, Shansi, and Tientsin to obtain detailed information regarding the quality, output, prices, and market for sheep wool in each of the districts, and his report is summarized as follows :—

Suiyuan—Kuishui and Paotow are the two principal wool markets in this province. Wool from Inner Mongolia is usually first sent to Kuishui, where it is distributed to various provinces for domestic consumption, the balance being for export. Among the chief varieties of wool handled are Sining wool (*tao mao*), and *chua mao, fu mao*. *Tao mao* has a very coarse fibre and is good only for making rugs, while the others have no standard quality, the best grade being used to weave fine woollen cloth and worsteds, which, however, are not very durable owing to the inelastic character of the fibre.

Paotow—is also an important transhipping center in the North-West, and formerly more than 40,000,000 piculs were exported annually. Sining wool, *urang-yeh-fu* wool, and camel wool are the most important varieties collected at Paotow, the second being especially suited to the weaving of fine cloth and worsteds. The price is rather cheap, only about $25 a picul, and the annual output exceeds 1,000,000 piculs. *Tao mao*, *chua mao*, and *fu mao* are also obtainable, but being of much inferior quality are sold at very low prices, and are used mostly for weaving coarse cloth, worth from 20 to 40 cents a foot.

The total annual production of wool in the Province of Suiyuan is estimated at about 4,000,000 piculs, classified into many varieties, as mentioned above. Part of the output is consumed locally for making shoes, hats, rugs, carpets, etc. Sheep are generally sheared in the spring and autumn, and the quantity clipped from each animal ranges from six to eight *liang*. Before the shearing season merchants used to make arrangements for the purchase of the wool shorn from a stipulated number of sheep, paying part of the price in advance. The merchants also paid the shearers.

Camel wool produced in Suiyuan is very fine, the total annual output amounting to from 4,000,000 to 5,000,000 piculs. It is a pity that China allows almost the entire production to be exported, for she should be able to manufacture carpets and various types of underwear equally good as those imported. Spring is usually the season for combing camel wool, the hair clipped in the fall being short and coarse.

Wool supplies from Suiyuan during the three years' period from 1929 to 1931 are approximately as follows :

	Year	*Piculs*	*Destination*
Camel wool	1929	3,751,454	Tientsin
" "	1930	4,507,006	"
" "	1931	2,317,728	"
Sheep wool	1929	23,595,482	"
" "	1930	18,698,752	"
" "	1931	6,371,906	"
Goat hair	1929	1,138,975	"
" "	1930	123,406	"
" "	1931	393,613	"

Kalgan.—Kalgan is a main gate to Mongolia, and was formerly a great fur and wool center as well as a noted pastureland. Since the declaration of independence of Outer Mongolia, coupled with the fall of Jehol, the importance of this city as a wool and fur market has greatly waned. There are at present only two or three fur *hong* operating in the district, handling last year approximately 3,000,000 piculs of wool and about 1,000,000 piculs of goat hair, with Tientsin as the chief buying port.

Wool prices in Kalgan vary greatly, that of *tao mao* or spring sheep wool being about $29 a picul, *tsien mao* or clipped wool, $24, and *chua mao* or combed wool, about $40.

Shansi.—In this province there are four wool centers—Chiaocheng, Yutze, Showyang and Tatung.

Chiaocheng—is the principal wool market in the southern part of the province, all the products from districts surrounding the south-western hills coming to this city, trading with Tientsin collectors average approximately 250,000 piculs, and more could be sold during good seasons. The local product is mainly of two varieties, *chun mao* or spring wool, and *chiu mao* or autumn wool, with varied quality though the fibre length is about the same.

Yutze.—Wool collected here comes mainly from such districts as Taiku, Kihsien, and Pingyao with Shunteh, Hopei Province, as the principal source of demand. It is estimated that about 300,000 piculs pass through Yutze annually.

Showyang—is situated about the middle of the Chengting-Taiyuan Railway, and produces the best wool in Shansi province. The annual output amounts to approximately 250,000 piculs, shipped largely to Shunteh at prices ranging from $14 to $30 a picul

Tatung—is the collecting center for wool produced in districts north of Yen-Men-Kuan. Lamb's wool and *chun mao* are the two principal varieties handled, the annual business amounting to about 150,000 and 200,000 piculs respectively. Lamb's wool, which sells about $40 a picul, is much superior to *chun mao*, which contains wool combed from dead sheep.

Tientsin—is the chief wool-trading center in North China, though not itself a producing district. Of the wool handled the most important varieties are *chun mao*, *chiu mao*, *tao mao*, Sining wool, and *hanyang mao* coming mainly from Shansi, Shensi, Kansu, Tsinghai, Suiyuan, and Chahar, as well as from Hopei, Shantung, and Honan. The fact that there are so many different varieties, each again subdivided into two or three grades, while most of the supplies are loaded with sand and water prior to shipment, causes prices to vary over a very wide range.

Wool for export from Tientsin is always washed before packing, each bale weighing 400 catties. Other details concerning Tientsin wool are supplied below :—

Wool	*Price per Picul*	*From*	*Suitable For*
Sining	$33.00	Sining	Tweeds and rugs
Sining (inferior)	28.00	Sining	Rugs
Su-Tsu	24.00	Kansu	Uniform cloth
Ying-Tsu	15.70	Kansu	Tweeds and rugs

Wool	*Price per Picul*	*From*	*Suitable For*
Hanyang	47.60	Taying, Shantung and Chengchow, Honan	Thread and serge
Hanyang chua-mao	90.00-100	Taying and Chengchow	Thread and serge
Hanyang Autumn Wool	60.00	Taying and Chengchow	Thread and serge
Shui chua-mao	75.00	Shunteh	Cloth and worsteds
Pi chua mao	60.00	Chiaocheng	Cloth and worsteds
Ninghsia *chin-mao*	35.00	Ninghsia	Yarn Felt hats
White wool, Lamamiao	40.00	Lamamiao	
White wool, Langshan	50.00	Langshan	Felt hats
Yulin purple wool	70.00	Yulin	Felt hats, hosiery and coats
Chua-mao, Showyang	30.00	Showyang	Tweeds and thread
Chiu-mao, Showyang	23.00	Showyang	Yarn
Fengcheng *chua-mao*	19.60-21.00	Fengcheng	Cloth
White Autumn Wool, Suiyuan	15.40-16.80	Suiyuan	Yarn
Suiyuan Yellow Autumn wool	10.00	Suiyuan	Yarn
Suiyuan lamb's wool	24.00	Suiyuan	Cloth
Suiyuan *chua-mao*	19.60-21.00	Suiyuan	Cloth
Tatung *chua-mao*, first grade	40.00	Tatung	Tweeds and thread
Tatung lamb's wool, first grade	40.00	Tatung	Tweeds and thread

The export of sheep wool, goat's wool and goat's underwool from Tientsin from July, 1932 to June, 1933 was as follows (in piculs):

	July	*Aug.*	*Sept.*	*Oct.*	*Nov.*	*Dec.*
Sheep wool	1,328.49	2,447.10	1,811.23	7,323.07	2,724.53	1,020.65
Goat's under-wool..	347.22	445.66	474.55	1,194.84	2,057.15	2,353.39
Goat's wool	228.58	466.42	656.12	851.39	362.02	337.91

	Jan.	*Feb.*	*March*	*April*	*May*	*June*
Sheep wool.. ..	5,000.74	4,253.27	2,784.38	7,008.66	18,336.95	33,056.05
Goat's under-wool..	1,846.22	821.48	1,158.90	1,364.38	629.88	959.92
Goat's wool . ..	235.83	—	60.74	165.15	0.85	138.75

Factory Plan

It is proposed that the State Woollen-Mill be on such a scale as to be able to turn out 6,000 bales of fine fabrics and 4,000 bales of coarse cloth a day, each having a length of 60 meters and a breadth of 1.40 meters. The yarn manufactured will vary between four and 12 counts for coarse varieties, and between 10 and 22 for the fine type. The factory is to be provided with the following machinery:—

Scouring Department.—Wool opener, conveyor lattice, wool-scouring bowl, automatic steeping bowl, wool press, automatic scouring bowl, three wool presses, automatic wool-dyeing machine (type E.V.R., 1½ h.p. and 50 kilogram capacity), two wool-dyeing machines (2½ h.p. and 100 kilogram capacity), two wool-dyeing machines, (4 h.p. and 150 kilogram capacity), universal dyeing apparatus (1.-2.5. h.p. and 5 kilogram capacity), two hydro-extractors (¾ h.p.), automatic wool-drying machine (7 h.p.), wool-cleaning machine (type A, 6 h.p.), single rag-grinder (15-20 h.p.), spare cylinder, spiral bladed beating willow (3-4 h.p.), and single garnett waste opener.

Combing and Spinning Department—Single opener card (type H105), two carding willeys (5 h.p.), three two-card sets (type H245), six three-card sets (type H335), two grinding machines (½ h.p.), two cast-iron emery-coated grinding rollers, two portable iron roller stands, set of auxiliary tools, turning apparatus, three self-acting mules (7 h.p. and 480 spindles), 12 self-acting mules (6 h.p. and 400 spindles), and three double-sided ring twisting frames (type U26, 380 spindles and 8 p.h.).

Weaving Department.—Six one-sided mechanical reels (type C, 60 spindles and ½ h.p.), cross winder (type KSM, 3 h.p.), five cone-warping and beaming machines (type QFH), hot-air drying and sizing machine (model LM3, 3 h.p.), and 90 looms (type Ak29).

Finishing Department.—Two rope scouring or washing machines (3 h.p.), three universal-washing machines, cloth-soaping machine, three milling machines, two sewing machines, suspended hydro-extractor with electro-motor, wire-card-raising machine, two double-cylinder teazle-rod gigs, universal wet-brushing machine, stretching, equalizing, and winding-on machine, piece-dyeing machine, suction machine, universal tentering and air-drying machine, complete rope-acidfying plant, rope-squeezing apparatus electric-hydro oscillation extractor (2.75 h.p.), patent-carbonizing machine, milling machine with beaters for treating carbonized cloth, steaming table, three shearing-machines with one cutter, rotary press with single rod (3 h.p.), brushing machine (2 h.p.), decatising machine with two copper-cylinders, original finishing and shrinking machine (2.7 h.p.), fabric inspecting and measuring machine, rigging, measuring, and rolling machine, and universal wet decatising machine.

British Equipment Supplied for Japanese Electrical Plants

(Continued from page 557)

ing type, that is to say their starting operations are to all intents and purposes automatic, and they are really of the simplest possible nature.

The arrangement of substations is such as to sectionalize the power supply to the railways, but power may be drawn from any substation, or, if desired, from all substations, the converters being suitable for operating in parallel with each other.

The use of high permeability cast steel is not, of course, confined to motor converters, but is also extensively used for direct current generators and motors, traction type direct current motors and similar electrical plant.

Another example illustrating the use of cast steel in the manufacture of electrical plant is depicted in Fig. 3. This is a magnet wheel for a 325 kilowatt alternating current generator for use in the Gold Coast. The design of the machine is generally similar to that adopted for slow and medium speeds but certain special steps had to be taken in connection with the construction of the windings as the conditions under which the machine operates are extremely humid and exceedingly severe lightning storms are experienced. Moreover, the machine is driven by a diesel engine and operates in parallel with other machines. The stored energy of the magnet wheel combined with the engine flywheel had therefore to be of such a value as would ensure satisfactory parallel operation under all conditions of service.

The high permeability steel castings referred to in this article are all of Edgar Allen manufacture, while Stag Major Superweld tools are used throughout Messrs. Bruce Peebles & Co., Ltd.'s works in connection with the machining of all their products.

Electrically Operated Excavators

(Continued from page 556)

generators. The exciter supplies all the separately-excited fields of the motors and generators through controllers and resistances, and also the field of the synchronous motor.

The driving units comprise twin 187 h.p. hoist motors, twin 62½ h.p. swing motors, and a single 125 h.p. crowd motor. All these machines are forced ventilated by means of individual motor-driven blower units taking their power from the 440-volt auxiliary supply.

The auxiliary equipment comprises a motor-driven air compressor arranged to start and stop automatically, depending on the air pressure in the receiver. A friction hoist fitted on the boom is driven by a 8 h.p. squirrel cage motor controlled by a direct-on-line contactor starter; and a dipper trip motor is operated from the 125-volt direct current supply through a contactor controlled by a latch operated push-button fitted on the crowd controller lever gear.

China International Famine Relief Commission Engineering Accomplishments 1932-1933

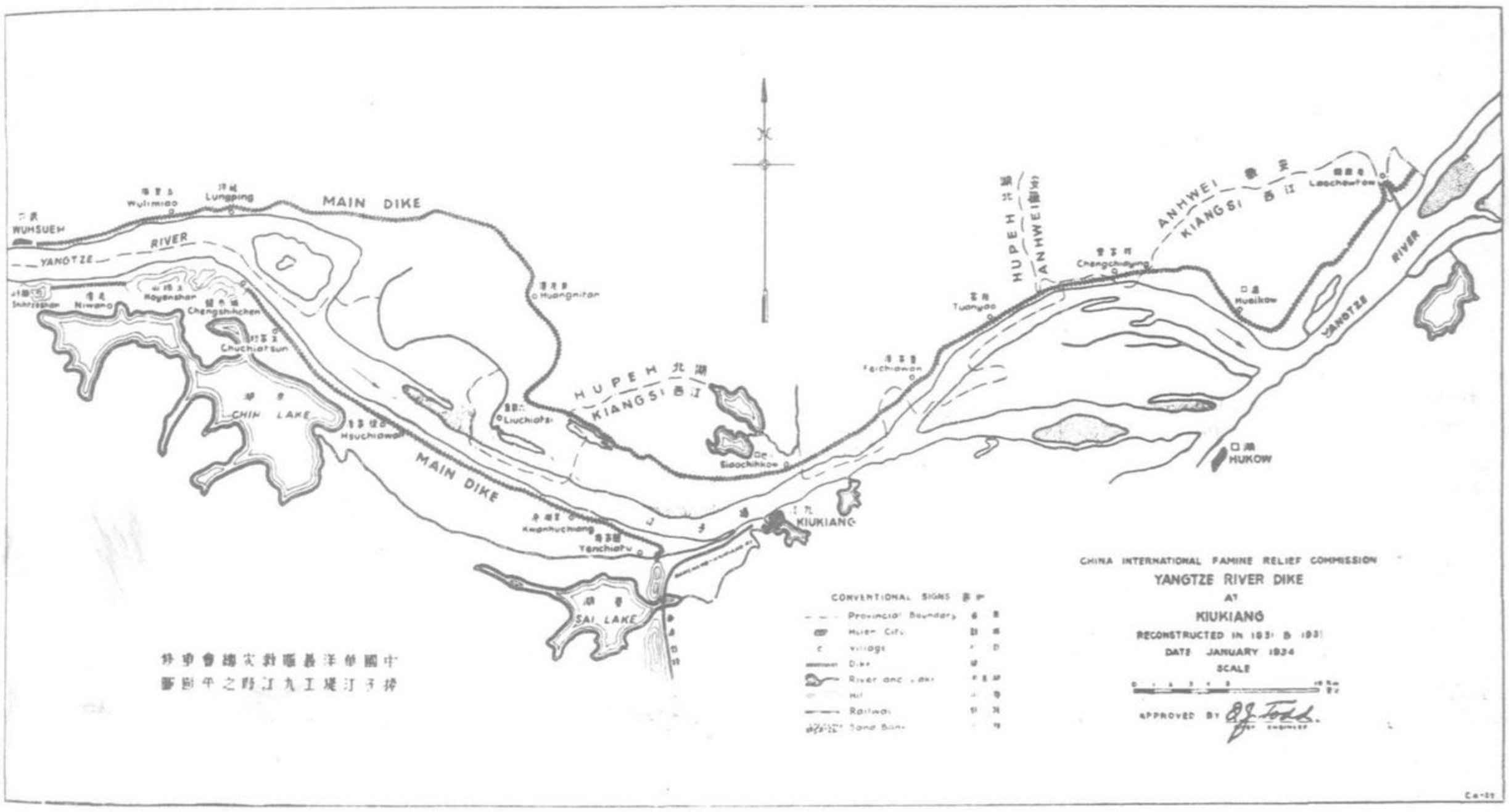
(The following is taken from the report of Major O. J. TODD, Chief Engineer, China International Famine Relief Commission)

Kiangsi and Hupeh

THOUGH the National Flood Relief Commission was organized to handle problems arising from the floods of the summer of 1931 in the Yangtze valley, our Commission was invited to share in the work of dike reconstruction and assigned the Kiangsi section, including a stretch in Hupeh close to Kiukiang. This work was undertaken by us early in January, 1932, with a special fund furnished by China Famine Relief, U.S.A., to cover all overhead expenses. The labor was paid for by the N.F.R.C. in wheat and flour shipped from America.

We established our main offices at Kiukiang where we kept in close touch with the rebuilding of the main dikes along the Yangtze. This work was completely under our control so that we were able to enforce our rules of thorough hand tamping of all earthwork in layers of less than one foot or compressing by the use of stone "flappers" thrown by six to eight men. The careful supervision of this work by our engineers insured embankment construction of a higher quality than had been previously known in Kiangsi. All these dikes were built to a height of one meter above the flood marks of 1931. Here the costs were less than 40 cents per fang for all of the work except for long distance carry. 15,000 men were employed at the peak of these operations.

Near Nanchang along the Fu Ho and near Tuchiapu, 40 miles north of Nanchang, we gave some supervision in reconstructing minor dikes. Here, however, our powers were very restricted and



中國華洋義賑救災總會委辦
揚子江堤工九江段之平面圖

The Kan River in flood a few miles below Nanchang, June 27, 1932

Bad break in Main North Dyke near Kiukiang, March 21, 1932

the people refused to follow instructions as to quality of work, size of section, height, etc. They insisted on a low factor of safety. Only on one or two of these local dikes were we able to enforce our rules. As a consequence high water in 1933 demonstrated to these people and the officials that it pays to follow the advice of experienced engineers. Practically all government supervised dike work in this region proved inadequate and with altogether too low a factor of safety.

Our work in Kiangsi and the short stretch in Hupeh near Kiukiang amounted to nearly 800,000 fangs. Additional work in a difficult section near the Hupeh-Kiangsi border amounting to 55,000 fangs was done in late 1932 and early 1933 by us at a cost of $20,000 furnished by the N.F.R.C.

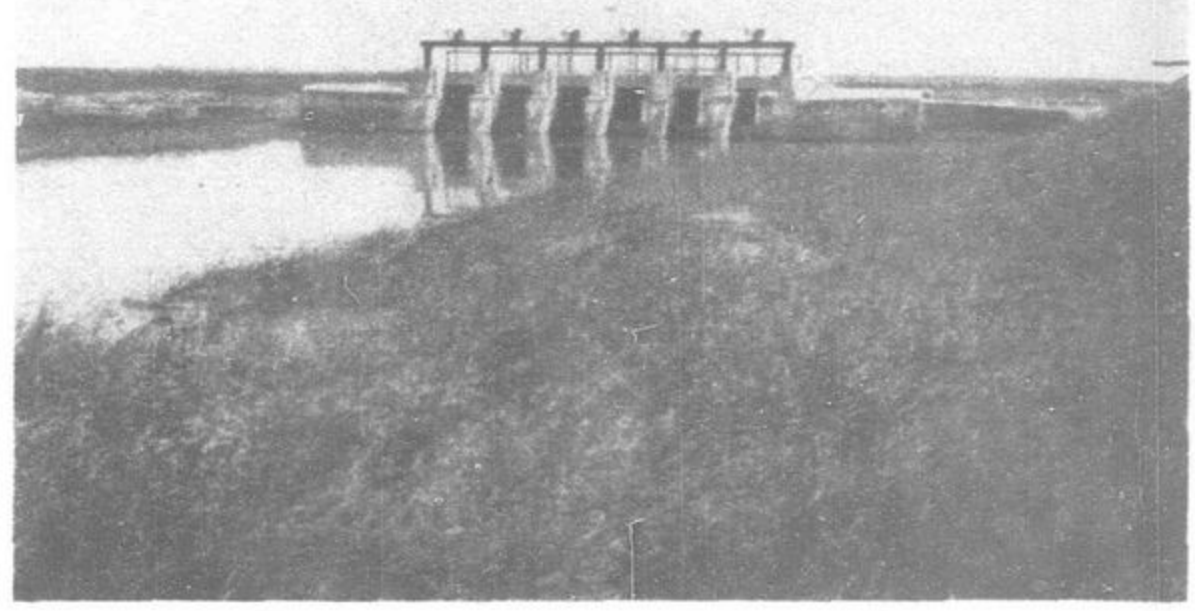
The Kiangsi Committee of the China International Famine Relief Commission financed and supervised the building of ten miles of new motor road near Nanchang on the west side of the Kan River in early 1932 at a cost of $25,000. This was started as a means of famine relief after the flood, with old funds belonging to our Kiangsi Committee.

At the same time this work was being carried on, the Chief Engineer of the Commission also acted as Consultant to the Director General of the National Flood Relief Commission, occasionally visiting other sections of the work along the Yangtze, particularly near Hankow, where many difficulties arose due to lack of suitable supervision and control.

Suiyuan

The Saratsi Irrigation Project, which had been dedicated in June, 1931, required some further work to make it complete and our

Using six-man concrete flapper on dyke work in West Kiangsi, April 21, 1932

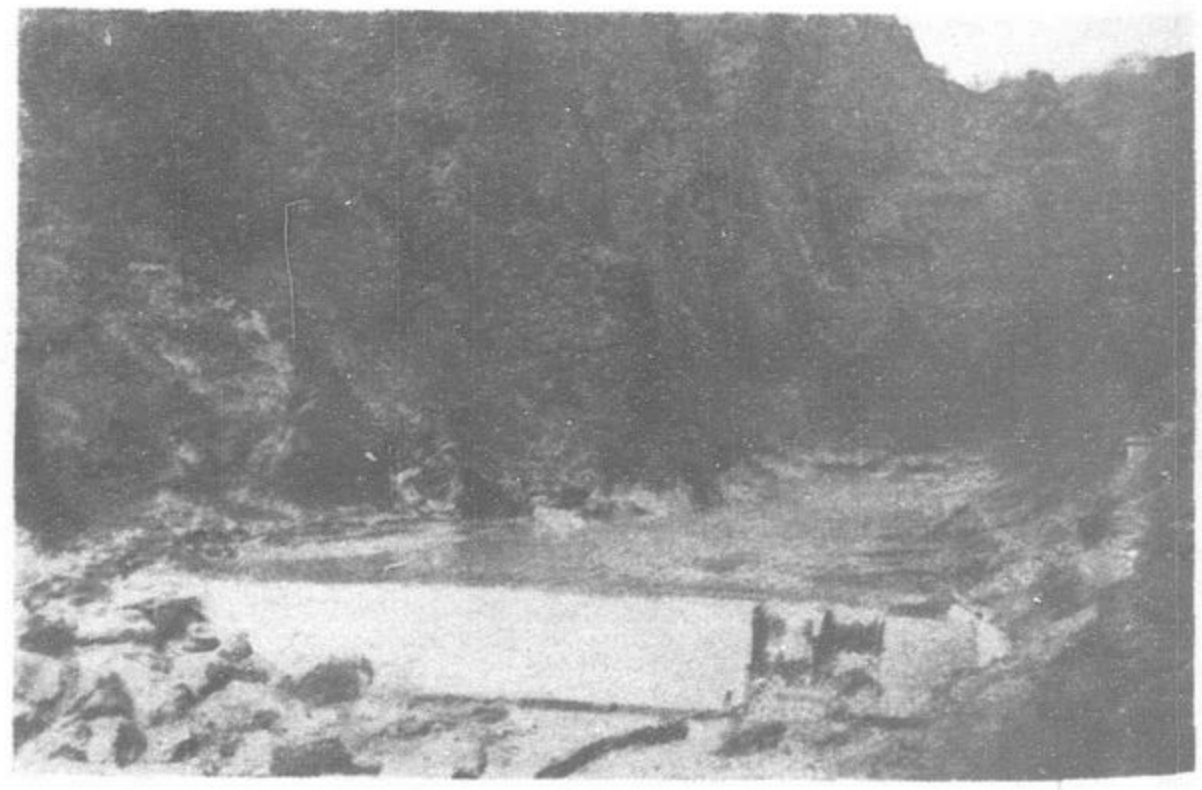


Check-Gate at east end of Main Canal, Saratsi Project, September 15, 1933

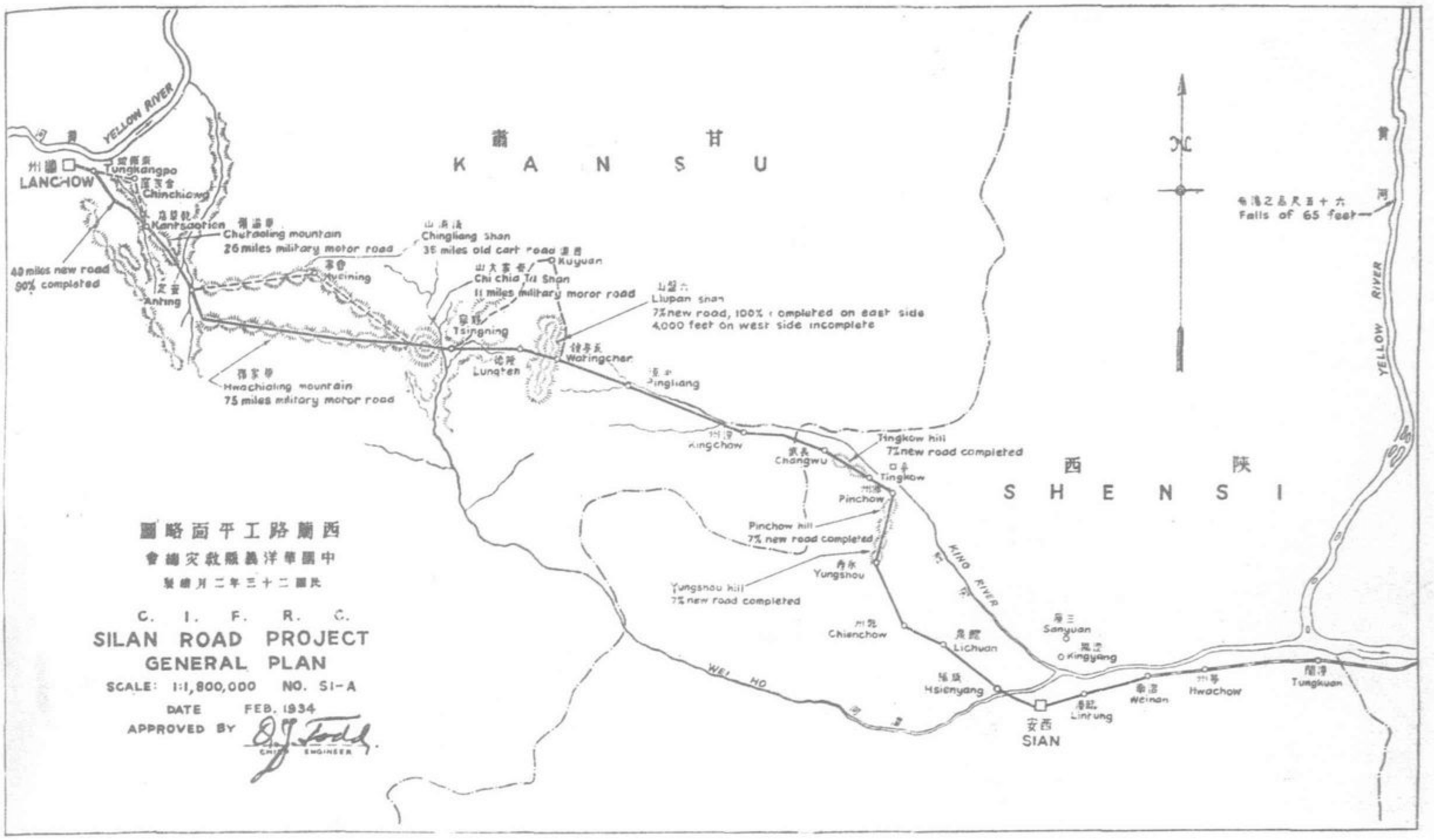
Yellow River at Saratsi Canal Intake, November 21, 1933

Using Wooden Tampers on dyke work near Kiukiang, March 28, 1932

A Drop on North Main Canal of the Wei Pei project, April 19, 1933



The Wei Pei Dam on the King River, April 19, 1933



西蘭路工平面略圖
中國華洋義賑救災總會
民國二十三年二月繪製

C. I. F. R. C.
SILAN ROAD PROJECT
GENERAL PLAN
SCALE: 1:1,800,000 NO. SI-A
DATE FEB. 1934
APPROVED BY O. J. Todd
CHIEF ENGINEER

engineers were engaged on this throughout the working season of 1932. This was chiefly in the line of earthwork, both on the main canal and laterals. Additional river protection was also done at the Intake and more stone quarried as a reserve for constructing the submerged weir when it is needed a few years hence.

At the close of 1932 this project was turned over to the Minshengchu Irrigation Association which engaged an agricultural specialist to manage the project. Engineers from the Commission were detailed to this work through 1933 to assist in further improvements and extensions of the main canal and laterals. They also gave service in making repairs necessitated by floods from spring ice jams in the Yellow River and from summer floods that came from the near-by mountains. The construction costs for improvements and repairs during these two years were approximately $100,000.

To make this project still more attractive to the farmers who will eventually settle on the lands so benefited, a scheme of improvement, extensions and upkeep has been devised as shown in Appendix II of this publication. This is a Four Year Plan for construction work and maintenance at a cost of $490,000, which is to be paid for from earnings of the project through water rates collected during this period of extension. It has been urged, however, that during this period our Engineering Department have ranking authority on the project as it is felt that no agriculturist should be expected to direct a large irrigation scheme during the years of its infancy and while it needs the immediate attention of a competent resident engineer to keep it in tune and train the local inhabitants in its proper use and up-keep.

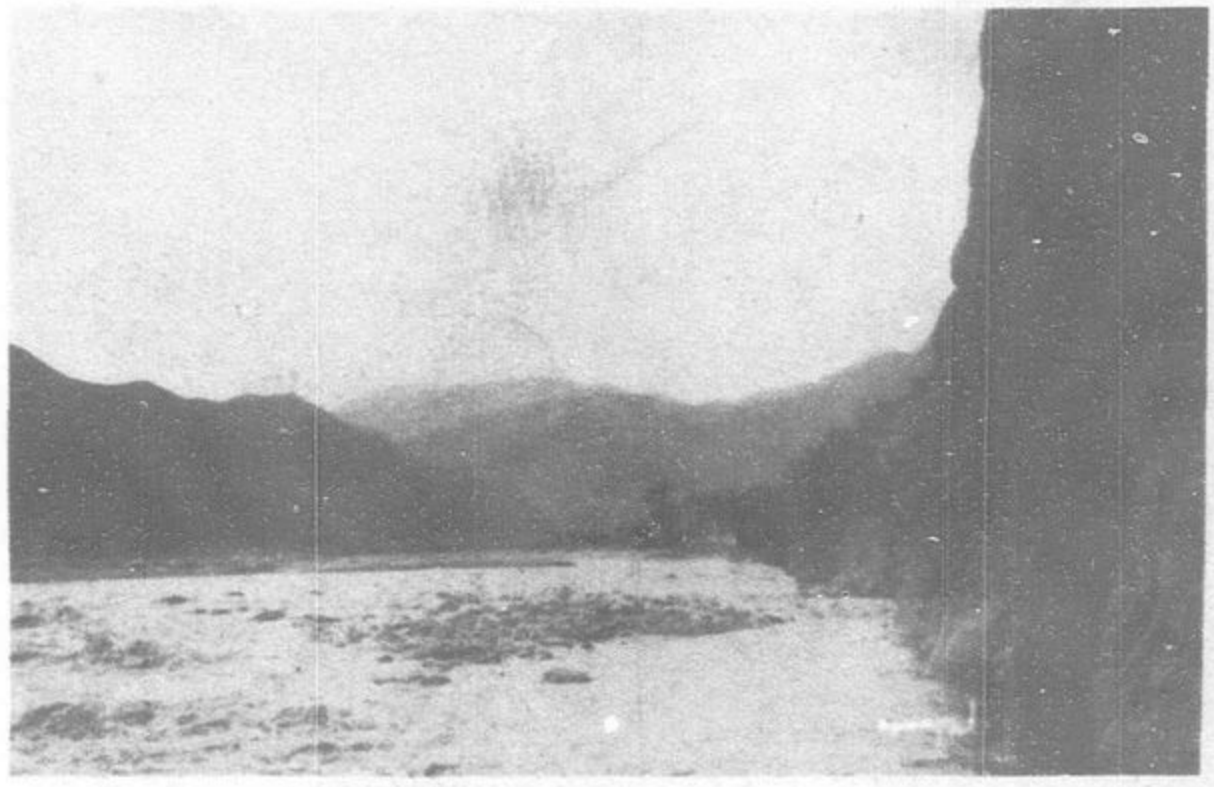
The National Economic Council has included this project in its program of public service utility improvements and may take the load of financing the Plan herein mentioned.

As yet funds are not available for making the much needed studies of the Ho Tao Irrigation Project to the west of Paoto. Fairly comprehensive field studies are necessary before estimates can be furnished or plans recommended for developing this area of 8,000,000 mou of flat land that is said to have 6,000,000 mou (1,000,000 acres) suitable for farming.

Shensi

The Wei Pei Irrigation Project, which was placed under the direction of our engineers in December, 1931, was successfully carried through the construction stage by the end of June, 1932,

On Liu Pan Shan East Slope, February 14, 1932



Looking up the Wen Yu Ho from Cha K'ou Dam Site, June 17, 1933

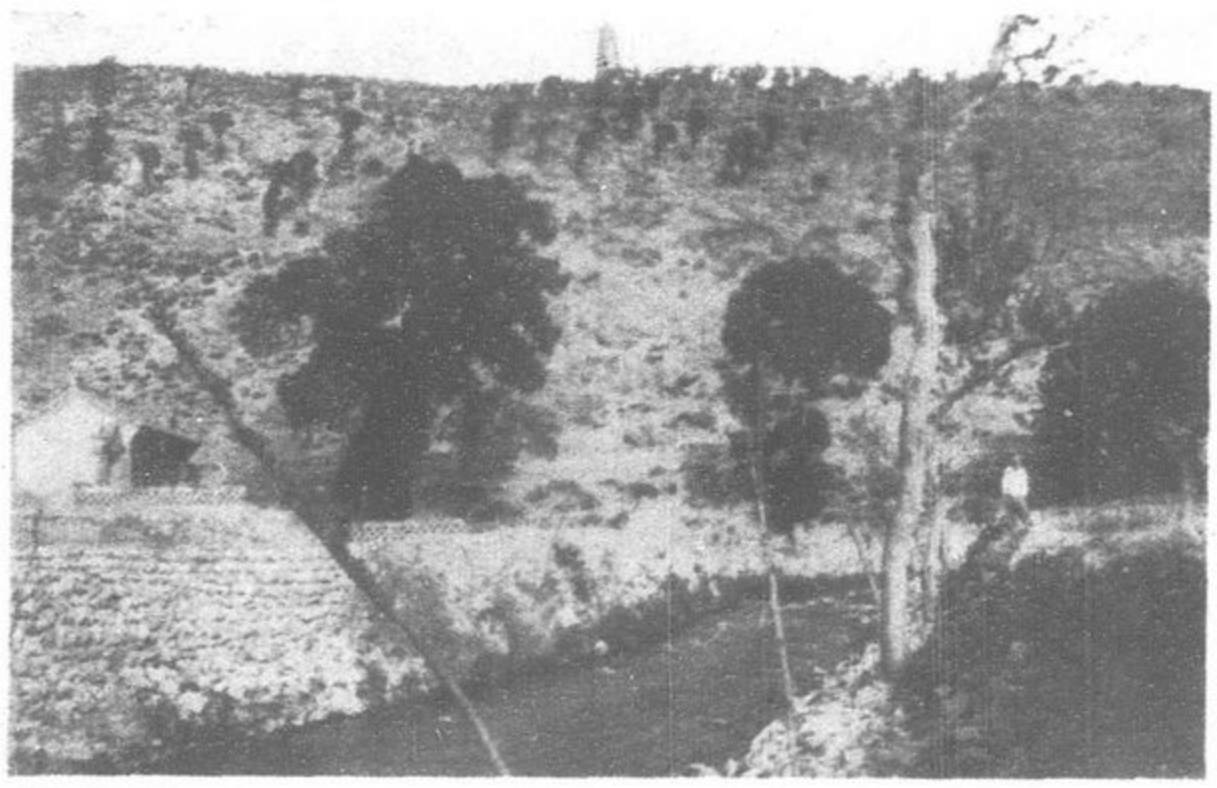
when it was officially dedicated and turned over to the Shensi Provincial Water Bureau for operation. This was the most notable activity of our engineering staff for that year. It meant the completion of an important piece of work costing $710,000 toward which China Famine Relief, U.S.A., had given $400,000, Chinese merchants and others in Honolulu had given $145,000, and the Hua Pei Relief Association had given $100,000. The Shensi Government made up most of the remaining funds.

This work included a masonry diversion dam across the King River, 1,200 feet of rock tunnel with head-gates, one mile of open canal in solid rock and a long stretch of deep cut through the foothills to the plains where hard conglomerate made work difficult. Bridges, aqueducts for carrying muddy waters over the main canal and other special structures were built in this section of the work which comprised the mountain section of Wei Pei Project. On the plain the Shensi Provincial Water Bureau assumed all responsibility for the construction and lay-out of the distribution system. This part of the work was not completed in 1932, however.

With an additional $89,000 from China Famine Relief, U.S.A., we gave aid through 1933 in extending the distribution system on the Wei Pei plain. We handled three of the principal laterals along lines laid down by the Water Bureau, doing both earthwork and special structures.

Diversion Dam on the Fen Ho near Chaocheng, Shansi, April 29, 1933

Looking toward No. 1 Dam Site on Fen Ho near Hsia Ching Yiu, February 25, 1933



Main Channel from Kwang Sheng Sze Spring 25 miles North-east of Pingyang, Shansi

Looking toward Liu Pan Pass from finished motor road 200 yards west

Looking West from Liu Pan Shan showing New Road Work

The Old Cart Road near top of Liu Pan Pass on West Slope, May 15, 1932

This work was undertaken by our Commission chiefly because of difficult famine conditions prevailing in this region in early 1933. Heavy rains in the summer of 1933 and the constant use of the irrigation system broke this famine before midsummer.

The benefits of this irrigation system are evident to any investigator. The project is a success and has contributed noticeably in 1933 toward the prosperity of Central Shensi.

Aside from the Wei Pei work our engineers also were occupied in Shensi during both 1932 and 1933 on the improvements to the Silan Road, which is the trunk line connecting Sian with Lanchow, Kansu. The work begun in the late spring of 1931 was prosecuted with vigor during the working seasons of 1932 and 1933, except for the autumn of 1932 when work was suspended due to the murder of a prominent member of our staff by a group of outlaw soldiers.

After the $350,000 donated by China Famine Relief, U.S.A. had been expended on this work, an additional sum of $200,000 was given us for this project by the National Government. With these funds our engineers have nearly completed regarding the seven worst hills on this route to maximum grades of seven per cent, have built many culverts and small bridges, and have made many line changes that will aid in facilitating motor traffic over this line. Some of the hills on the old road had gradients from 20 per cent to as high as 33 per cent for short pitches. Most of the old alignment on the hill roads had to be abandoned. The new loops increase the length by a number of miles, making the new road nearly 480 miles long.

Kansu

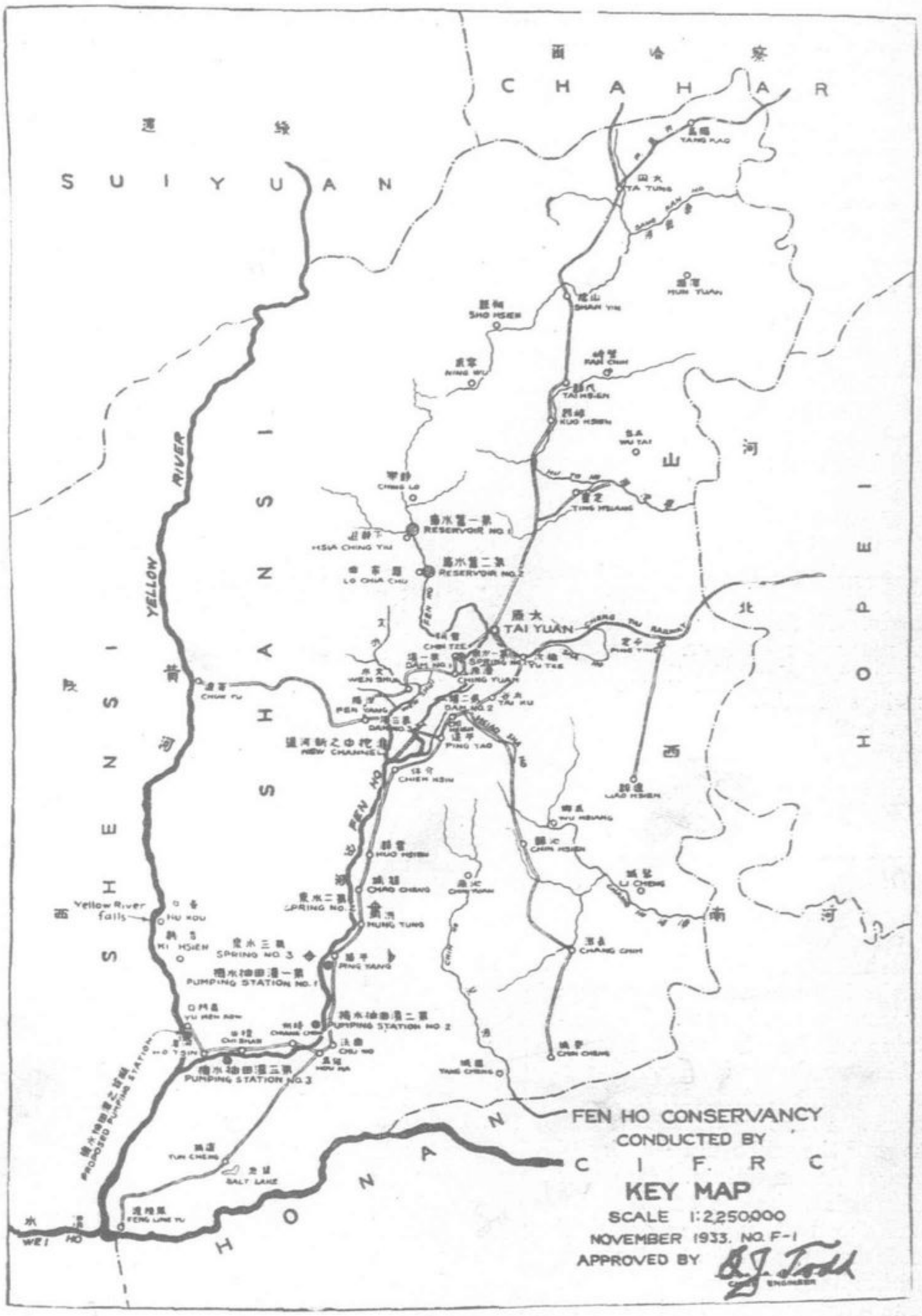
The Silan Road is an inter-provincial project, and in Kansu we had some of our most difficult work. While working in Shensi we also worked in Kansu. During 1932 and 1933 our work in Kansu was principally on a 40 mile detour starting from the eastern border of the Lanchow plain and running to the south-east. This section has cost nearly $200,000 including some difficult bridging and drainage tunnels. It was almost completed at the beginning of 1934,

The most picturesque feature of this road is also in Kansu and is the section that traverses Liupanshan, crossing the pass at an elevation of approximately 9,000 feet. Much of the grading on the slopes of this mountain has been in rock, so that a total of over $150,000 has been expended here. Less than a mile of this mountain section remains uncompleted.

Heavy rains in the summer of 1933 destroyed a number of small bridges and showed the need of making improvements beyond those contemplated when this work was started in 1931 after a long dry cycle. Certain low lying stretches of the road proved to be almost impassable for auto traffic for several weeks when the rainy season was at its height. The clay soil was sticky and cart or animal traffic made drainage conditions bad. The need for gravelling or macadamizing certain sections was apparent. A program has therefore been submitted to the National Economic Council by us recommending a program for 1934 was indicated hereinafter under Appendix III.

Shansi

Floods in the Taiyuan valley of the Fen Ho in Shansi Province in the summer of 1932 caused heavy losses to farmers and villagers in several counties and particularly at the lower end of this famous and productive valley. The city of Taiyuanfu also suffered from the floods. As a result of preliminary investigations our Commission had its Chief Engineer go over the field in September of that year. The need for river control work was evident. He outlined his ideas in connection with a solution of this problem.



In early November of that year he again went into Shansi with Dr. David A. Brown, of China Famine Relief, U.S.A., who urged the Shansi authorities to present a properly prepared plan based on reliable engineering studies before approaching our Commission further for funds to aid in a flood prevention program.

As a result of these visits and conversations the Shansi Government set aside the sum of $100,000 as requested by our Chief Engineer and invited our Commission to make the required studies and prepare a report with a plan for water conservancy as an aid to irrigation in dry years and river regulation as a safeguard against flood damages in wet years. Our Chief Engineer was put in charge of this investigation and given full powers to conduct thes tudies. He took the first survey party into the field in late February, 1933.

By the end of 1933 the studies necessary for the preparation of the Fen Ho Report had been practically completed at a cost of $65,000. Other studies had also been made of the old irrigation canal systems along the Sang Kan Ho in North Shansi. The main work of the year was on the Fen Ho, including two important tributaries and three large springs that water adjacent farm lands and then discharge into the Fen Ho. During February of this year (1934) the Fen Ho Report was issued, giving the result of these studies with ample illustrations by means of photographs, maps, sketches and tables.

In presenting this plan to the Shansi Government it is recommended that the work of construction be spread over five years or more. Several parts of the work may be undertaken during 1934

to advantage. The three irrigation districts of Hsiang Ling, Chiangchow and Hotsin, served by pumping plants built in 1930-31 under direction of Mr. L. H. Wang, should be completed and put on a paying basis. The three diversion dams built of masonry to replace the former eight earth dams built annually along the Fen Ho in the Taiyuan valley should be completed at an early date. Quarries should be opened in the spring of 1934 to produce stone where minimum haul is possible to get material to revet the banks of the new straightened channel which is proposed for the Fen Ho.

In the autumn of 1933 our engineers supervised the digging of an inner channel nine miles long between Pingyao and Chiehsiu to straighten the river's course. This is but a short section of the 70 miles of straight channel needed to control floods between Taiyuan and the lower end of the Taiyuan plain below Chiehsiu. The dikes of this new channel should have stone protection at once.

The Fen Ho plan calls for an expenditure of $12,700,000, of which something over $8,000,000 is for flood control while nearly $5,000,000 is for water conservancy for irrigation to insure crops in dry years or to increase crop production in ordinary years. It includes the building of reservoirs both on the main river and below the three large springs of Chintze, Kwang Sheng Sze and Lung Tze Sze, which average nearly 90 cubic feet per second from each spring in regular flow. The winter flow from these is needed to supplement the low-water flow of the Fen Ho in the spring months.

These studies made in Shansi during 1933 indicate that the Fen Ho Conservancy is a work of major importance and for several reasons a most practical undertaking. As is well known, China needs to develop areas of stabilized government where a good start has already been made toward the peace and security of the ordinary citizen. Probably Shansi has the greatest security and the best policing of all of China's provinces. Banditry within its borders is rare, indeed. The climate and land fertility are such that the Fen Ho valley is a good food producing region and well located to supply food by rail to other northern provinces. Shansi is a picturesque province and a pleasant place for people to live. The natural surroundings contribute to happy rural life. As an investment for profit this conservancy work in Shansi is sound. It is also a most practical plan because it can be carried out step by step through a series of years with tangible benefits long before the whole program is carried out.

Aqueduct for Passing Flood Water over Main Wei Pei Canal near Mushuwan, April 19, 1933

The adoption of this plan depends very much on the ability of the Province to arrange the necessary financing which will require support from various quarters. If co-operation comes, as it should, the China International Famine Relief Commission can be of tremendous help in the work of restoring former prosperity in this part of China and making permanent improvements that will have a marked effect on future generations of North China.

Surveys continue with the remainder of the sum of $100,000 set aside a year ago. These other studies now going forward in 1934 cover investigations of the upper Hutu Ho and the Chang Ho for irrigation improvements. They also include studies of the Yellow River water falls on the west boundary of Shansi. Engineers are now engaged on these surveys. Studies of a small hydro-electric development near Chuwo in south-central Shansi are also being made.

These rather intensive field studies conducted in 1933 are the most complete ever made by our Commission and mark the beginning of a type of engineering that is most desirable if extensive permanent work is to go forward in the line of famine prevention. The former practice of making hurried perparations for construction work where little advance study has been carried out has embarrassed our engineers in the past, but the very nature of famine relief work often compels such action. It is a satisfaction to all concerned that these advance studies in Shansi have been permitted. It is also most gratifying that one province has generously paid all costs of such studies. No record exists of such far-sightedness in our experiences in China to date. It indicates an earnestness of purpose that should beget confidence from the public generally.

In 1932 one preliminary study was made of a proposed route for a motor road 70 miles long from Chinchow to Liaochow. Preliminary estimates of the cost of this road were made by us, but as yet no move has been made to construct this connecting link betwen the Pingtingchow-Liaochow Motor Road (built by the American Red Cross is 1921) and the Taiku-Chinchow-Luan Motor Road (built by the Shansi Government in 1930). Our engineers are surveying two other roads in the early months of 1934. One will connect the main Fen Ho Valley Motor Road near Pingyangfu with the Hu-Kou falls on the Yellow River, a distance of nearly 80 miles. The other will connect the Taiyuan-Tatung Motor Road 20 miles north of Taiyuan with the Fen Ho near Lo Fan as an aid to the construction of our storage reservoir on the upper Fen Ho.

In the year 1934 our greatest work seems to lie in Shansi, and there most of our engineers are engaged in the field just described. It is part of a comprehensive and most interesting conservancy problem that is distinctly in line with our work of famine prevention.

Acknowledgment is hereby given to all the various organizations and individuals who contributed to the work described in this Report. Some gave of their time freely while others gave money. Of donors by far the most outstanding has been China Famine Relief, U.S.A., whose generous financial aid has made possible the three largest projects described herein. These are the Silan Road, the Wei Pei Irrigation Project, and the Saratsi Irrigation Project. This same American organization also gave $170,000 (silver) to pay overhead cost, etc., on the dike reconstruction work in Kiangsi in 1932, and for two years carried the salary of the Chief Engineer.

Peking-Hankow Railway

Chinese banking interests have completed final arrangements for a loan of $30,000,000 for the Peking-Hankow Railway. The main purpose of the loan is to finance the repair of the Yellow River Bridge of the line which for some considerable time now has been seriously in need of attention and, during the recent floods, gave signs of being dangerously impaired. In addition, much of the funds will be available for the restoration to a high state of efficiency of the railway workshops of the Pinghan Railway, the largest of which is at Changhsintien, the next at Hankow, and the smallest at Chengchow.

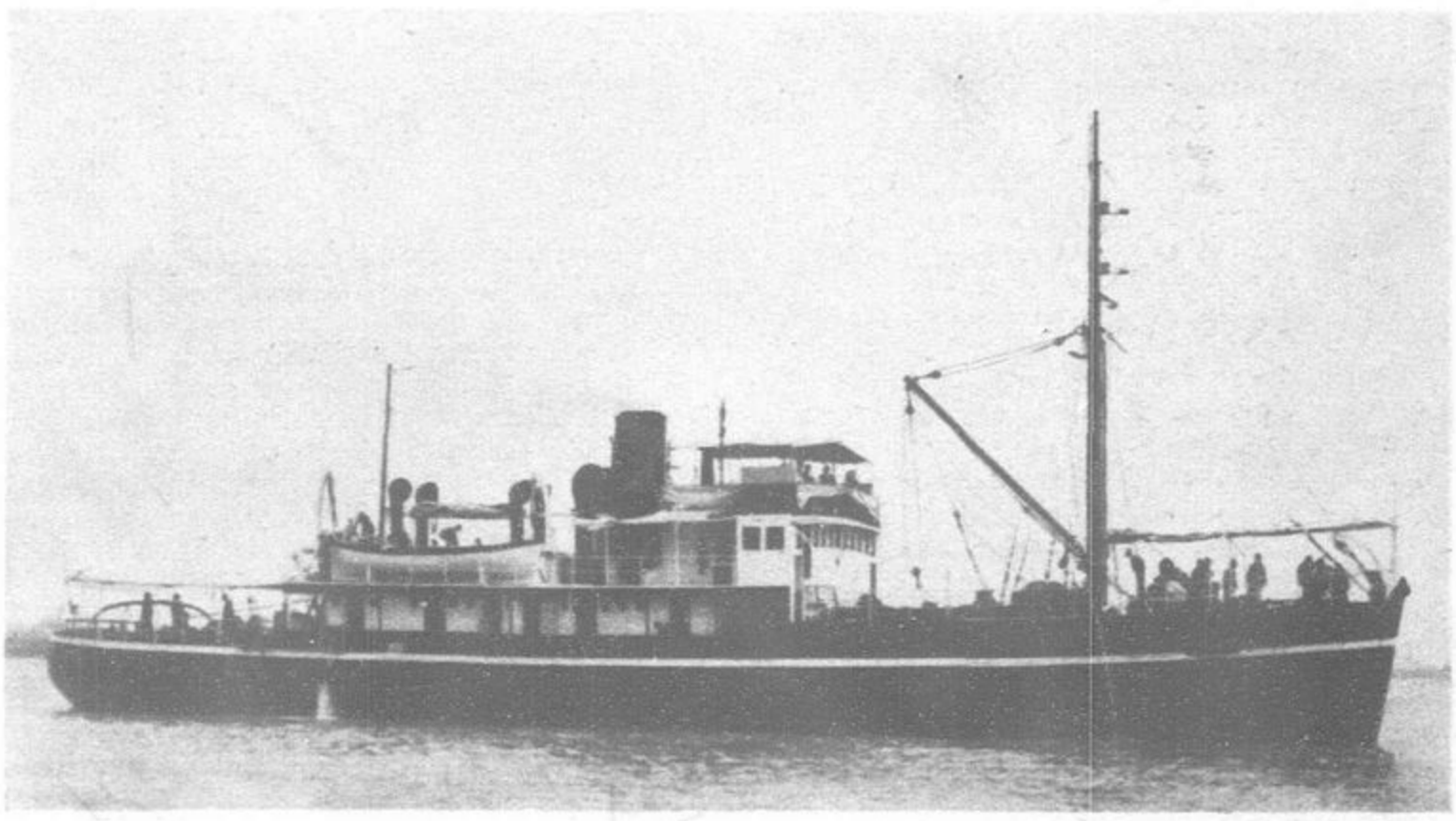
Dredging the Fairy Flats*

"*Li Liang*," New Service Vessel for Work in Yangtze Estuary Completes Trials

ANOTHER step towards the realization of the gigantic scheme for the dredging of the Fairy Flats, the ever-increasing obstacle in the Yangtze to the entrance of big ships into Shanghai harbor, has been made by the launch and successful trials of the *Li Liang*, the special service vessel built by the New Engineering and Shipbuilding Works, Ltd., for the Whangpoo Conservancy Board.

The *Li Liang* has been specially built as a tender to co-operate with the huge suction dredger recently launched in Germany and which is expected to arrive in Shanghai under tow at the end of March. The dredger, which is believed to be one of the largest in the world, will undergo trials and then work will be commenced on dredging a wide and deep channel through the flats, which at present give only seventeen feet depth at low water. It is the aim of the Whangpoo Conservancy Board to concentrate on one dredger, but if needs be another may be constructed to ensure successful completion of the project.

At the Board's station at Woosung, a wharf is being built to accommodate the dredger and tender, and buoys have also been placed in position in the Whangpoo River for the vessels, but the main purpose of the *Li Liang*, will be to act as feeder for dredger and undertake survey and buoy work as the dredging proceeds. The magnitude of the task to be undertaken by the Board has often been described and the urgency of Shanghai's shipping needs are increasing.



The Steamer "Li Liang" Built by the New Engineering Works for the Whangpoo Conservancy Board

Trials of the *Li Liang* have been proceeding from the New Engineering Works yard at Yangtszepoo for some time but final acceptance trials were held in November when the vessel, with Whangpoo Conservancy Board officials on board, proceeded down the Yangtze and was subjected to the usual runs along the measured mile and also fuel consumption and other trials. In addition to members of the Dock staff there were on board Mr. Y. Utne, Chief Surveyor of the Board, Mr. C. P. Hsueh, Senior Assistant Engineer, Mr. R. Macfarlane, Workshop Superintendent, Captain K. Kristensen, who will command the *Li Liang*, and Mr. F. Wolmar, Chief Officer.

Unusual Features

As the vessel was built for special purposes, it possesses features not seen on other ships. Shuttling back and forwards from the dredger down the river to the wharf at Woosung and doing survey and buoy work as the dredging proceeds, she is a floating store-house and workshop with special equipment for handling buoys and pumps and tanks for discharging oil for the dredger at sea. A searchlight and an echo-sounding device are other features and the wireless equipment includes a wireless telephone which will keep the Board's officials in the Custom House in touch with her.

The vessel has a lower, main, forecastle and boat deck and the main dimensions are:—Length over-all, 150-ft., moulded breadth 30-ft., moulded depth 16-ft., loaded draught 10-ft. She is built of steel to Lloyd's Rules, and is subdivided into seven watertight compartments by six watertight bulkheads extending to the main deck. The vessel has a raked stem and cruiser stern, and has been built with two steel decks, sheathed with teak and Oregon pine, the lower deck in way of the officers accommodation is laid with insulite.

On the boat deck, the wheelhouse, and wireless room are located. The officers' accommodation is situated on the main deck aft and includes a spacious and comfortable wardroom. There is a large refrigerator in the pantry on the main deck and also a lift for serving the pantry in the wardroom. The petty officers are located on the main deck and there is accommodation below for a crew of 20.

The Machinery

A powerful combined steam windlass and capstan of naval pattern is installed on the forecastle head for the efficient handling of the anchors also two five ton winches for handling buoys, a steam capstan is fitted on the main deck aft with suitable leads for warping and handling the ship's cutter and gig. The vessel is also fitted with steam steering gear.

The propelling machinery for this vessel has been specially designed and constructed by the builders at their Yangtszepoo Yard, and consists of two sets of three crank triple expansion, surface condensing engines developing ample power to give the vessel a speed of over 10½ knots, and operating under steam supplied by one single-ended three furance, cylindrical Scotch boiler, also designed and constructed by the builders, burning coal under the well-known "Howden" system of forced draught, and operating at a pressure of 100 lb. per sq. inch. The auxiliary machinery is of the best modern type, all independent of the propelling machinery, and includes a surface condenser of the regenerative type, of mild steel, common to both engines, one Weirs Paragon air pump, one centrifugal circulating pump, two Weirs main feed pumps, and one Weirs feed heater. An ash ejector pump and a bilge and general service pump are also fitted.

The vessel is lighted throughout by electricity, current being supplied by duplicate sets of Diesel-engine driven generators. One searchlight and a Marconi wireless installation and an echo-soundign machine, of Henry Hughes & Sons make, form part of the equipment.

This vessel was built and equipped to suit their own special service and the construction has been supervised by representatives of the Whangpoo Conservancy Board.

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* *The North-China Daily News*

Dutch East Indies

The return of normal trading conditions in the Dutch East Indies has brought with it an increased demand for portable and cabinet gramophones and radio-gramophones, particularly in such towns as Macassar, Batavia and Medan. Local manufacture is non-existent, and United Kingdom makes of the latest types meet with a ready and extensive sale. It should be noted that radio-gramophones must be adapted to shortwave reception, and be fitted with rust-proof metal parts to withstand the severe atmospheric conditions common to the territory.—*The British Export Gazette.*

Engineering Notes

INDUSTRIAL

STEEL WORKS FOR SHANGHAI.—Plans for converting the former Lunghua Arsenal in Shanghai into an iron and steel works are being made by the Ministry of War. With the outbreak of the Sino-Japanese hostilities in 1932 a large portion of the machinery of the arsenal was removed to the Nanking and Hanyang Arsenals. Later, the Ministry contemplated sale of the land, the proceeds to be ear-marked for the expansion of the Nanking and Hanyang Arsenals. To promote the development of domestic industries, it is now learnt that the Ministry is contemplating the erection of an iron and steel works on the site.

TIN PLATE IN CHINA.—A Kuala Lumpur (F.M.S.) writer states that a yearly average amount of $10,000,000 worth of tin will be required within the next few years by the China Can Co., Ltd., for manufacturing tin-plate. Negotiations for the supply of the metal are being carried on in Kuala Lumpur. The China Can Co. intend to erect immense factories in Hongkong and Shanghai to manufacture tin-plate and iron-plate, for which there is a huge demand in China. Up to the present the company has been buying manufactured tin-plate from England and America to be lithographed in their factories. Tin-plate manufactured on the spot would mean a great saving, a big development of the industry in China, and an increase in the amount of tin imported from Malaya. The machinery and factories have already been planned, but their completion will take at least two years. Mr. Aw Boon Haw, the well-known Singapore Chinese, is chairman of the company, and he was responsible for effecting one of the biggest combines in China when the Industrial and Trading Co., Ltd., of Shanghai, was merged with the China Can Co., Ltd., of Hongkong.

RECONSTRUCTION OF HARBIN.—The complete reconstruction of the city of Harbin has been confirmed by a special committee in the capital. The huge sum of $35,000,000 is to be spent during the space of five years, of which $22,000,000 will be spent in the first three. The city is to be divided into four basic districts—commercial, industrial, special living residences, and suburban, including parks, squares, etc. The construction of a water and drainage system has been sanctioned, and a special place will be assigned for a central market. Other points include the transfer to the Municipality of the tramways and motor-buses. Remembering the terrible flood of 1932, the whole of the river bank will be reconstructed so as to protect the town from any possible overflow. To guarantee the financial side of this plan, the head of the Department of General Affairs of Manchuokuo has gone to Tokyo, where he has concluded a loan of Y.20,000,000 with Japanese bankers, thus making it possible to commence work at once. The South Manchuria Railway Company intends to construct a new hospital in Harbin at a cost of Y.350,000.

AVIATION

MANILA-SHANGHAI LINE.—The China Aeronautic Company, heavily endowed with American capital and largely under the control of the American Air Company, has just obtained permission of the Chinese government to extend the Shanghai-Canton line to Manila and establish a Sino-Philippine air line. Already two successful tests have been conducted, and the company is to open a regular schedule. The establishment of this air route by the company with American capital is regarded as not entirely devoid of military considerations.

SHANGHAI-CANTON AIR SERVICE.—Air-mail and passenger service on the Shanghai-Canton Airway, suspended since the early part of the year following the air-plane disaster near Hangchow Bay, was resumed on October 10, National Independence Day.

PAOTOW TO BE AIRPORT.—The Eurasia Aviation Corporation has decided to extend the Lanchow (Kansu)-Ninghsia airway to Paotow, western terminus of the Peiping-Suiyuan railway. Work on the construction of an aerodrome at Paotow has been started and will be completed shortly.

CHENGCHOW AERODROME OPENED.—The new aerodrome at Chengchow, of the Eurasia Aviation Corporation for the Shanghai-Sinkiang and Peiping-Canton Airways was opened on October 16. Airplanes on the Peiping-Canton line will hereafter call at Chengchow instead of Taiyuan, Provincial capital of Shansi.

CHUNGKING-YUNNAN ARI-ROUTE.—To realize the plan for the early opening of an airway between Chungking, in south-eastern Szechwan, and Yunnanfu, provincial capital of Yunnan, it is reported that the Ministry of Communications has remitted a sum of $50,000 to the China National Aviation Corporation towards initial expenses. In view of the mountains along the projected route, the Corporation has placed an order in the United States for the most up-to-date airplanes. Plans for refuelling and other facilities are also being made by the Corporation. General Lung Yun, Chairman of the Yunnan Provincial Government, states that the Yunnan Provincial Government will be responsible for the construction of the aerodrome in Yunnan and the installation of radio facilities.